

ROADS AND STREETS

Design, Construction, Maintenance and Traffic Control

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Established 1906



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March, 1931

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*See the Road and Street Catalog & Data Book

In addition to the advertising messages to be found in this issue of Roads and Streets on the pages as indicated above, condensed catalogs of those marked * as well as other specifications and construction data will be found in the Road and Street Catalog and Data Book, the 384 page annual reference guide for the highway industries, published by the Gillette Publishing Co.



Olsen Portable Transverse Brick Testing Machine

Applies and indicates load up to 4,000 pounds. It is provided with handle and carrying case. Weighs only fifty pounds.

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For Cement, Concrete, Sewer Pipe, Reinforcing Bars and Road Materials.
OLSEN Balancing Machines Dynamically balance all rotating parts
TINIUS OLSEN TESTING MACHINE COMPANY
504 North 12th St., Philadelphia, Pa., U. S. A.

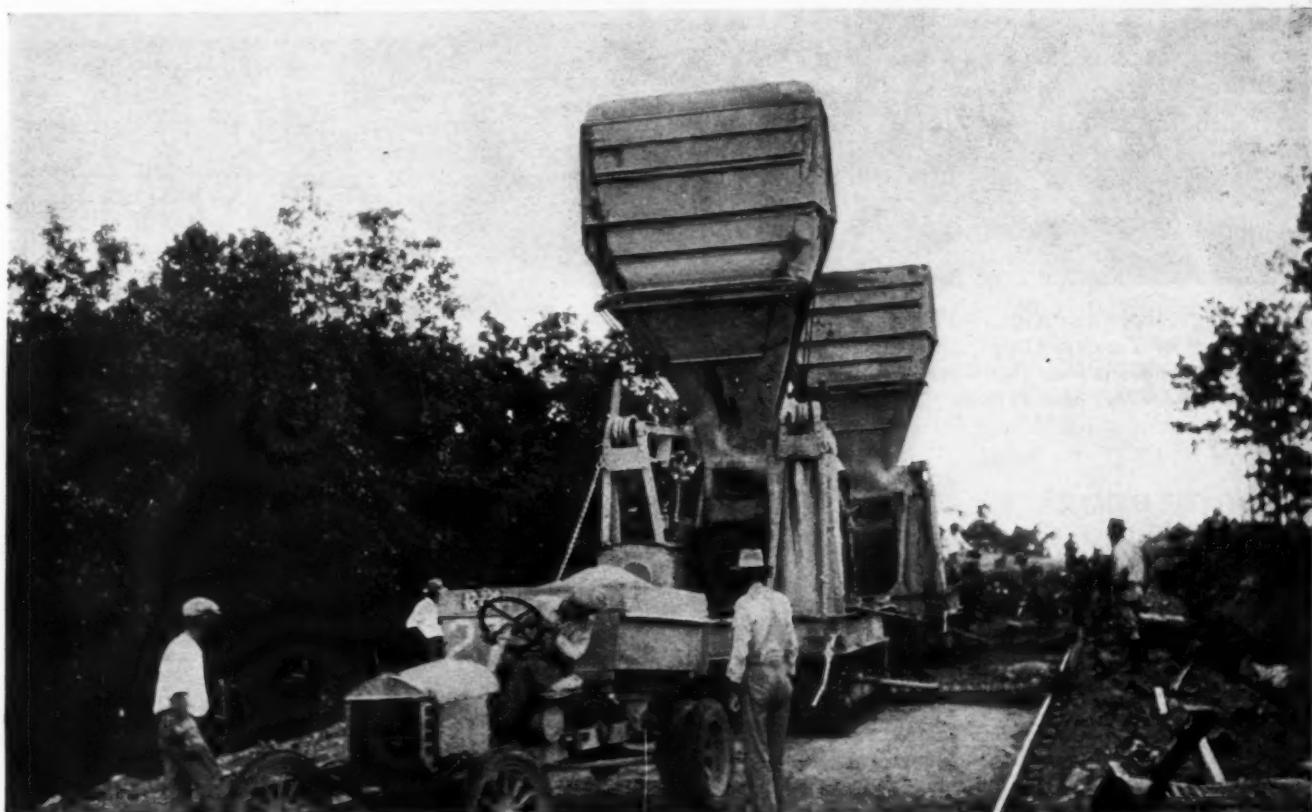
ROADS AND STREETS

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Vol. LXXI

Chicago, March, 1931

No. 3



Tandem Outfit of Hoeffken Bros. Construction Co.

TANDEM PAVING JOB *Shows Increased Production*

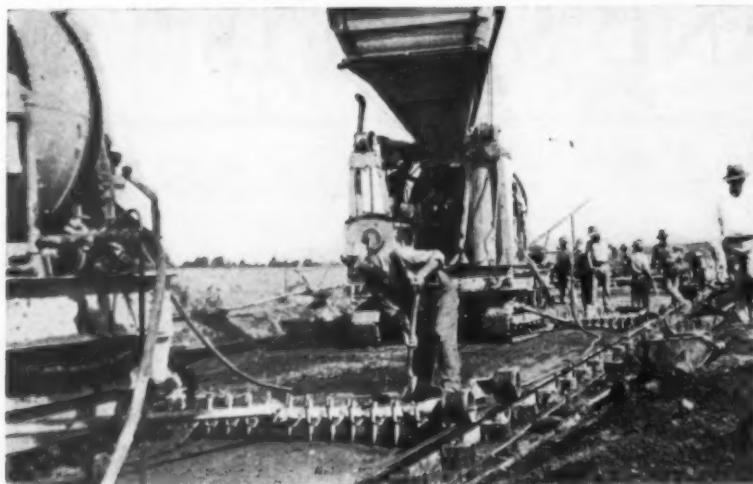
THE tandem plan of operating two pavers was successfully put into practice by the Hoeffken Bros. Construction Co., of Belleville, Ill., in constructing 12 miles of Missouri project 307-A in Dallas County. The total mileage embraced by the contract was 38½ miles. Of this total, the first 26½-mile section was constructed by two single paving outfits; these outfits were then combined into a tandem outfit to construct the last 12 miles.

Since the two methods were used on the same contract, the results give a good comparison of the tandem system with the one-paver plan of operation. It was found that the tandem system resulted in an increase of output of approximately 60 per cent with, of course, an increase in labor and hauling and material-handling equipment over that required for a single-mixer outfit.

The pavement consists of a 20-ft. slab with a 9-6-9-in. cross-section. Lip curb was used throughout the work

to prevent run-off from eroding the shoulders. Aggregates were stored in five stockpiles along the 38½-mile route by M. E. Gillioz, of Monett, Mo., under a separate contract. Cement was hauled long distances from two railroad sidings by the paving contractor.

While operating in tandem the pavers were not connected. Batches were mixed 35 seconds in the drum of the first paver and discharged into the skip of the second which continued the mixing an additional 40 seconds, making a total of 75 seconds. It was found that the additional mixing and rehandling improved greatly the workability of the concrete. The average run for the single paver was 90 ft. per hour and the best day's run was 1,492 ft. in 13½ hours. The tandem outfit demonstrated an ability to average 150 ft. an hour, having made 1,882 ft. in 12 hours 35 minutes and 950 ft. in 6 hours 20 minutes. These runs are typical for adequate hauling equipment. However, the newness of the tandem ar-



Above and Right—Views of Tandem Outfit, Showing Various Positions of Mixers and Skip of Second Mixer

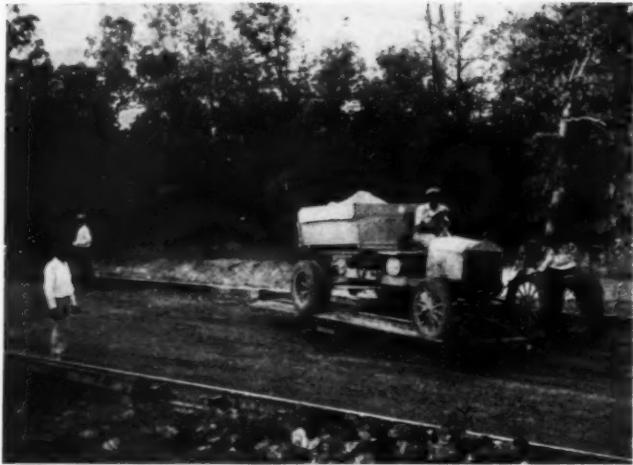


Below—View of Plant Layout



Subgrading Operations

View of Duo-Rail Forms; Finisher in Background



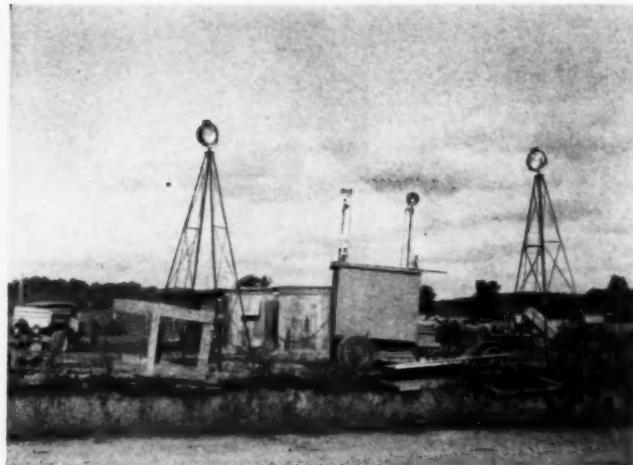
Turntable Used for Turning Trucks

rangement and the occasional breakdown of trucks—which had already hauled materials for the 26½-mile section—caused delays in the regular supply of aggregates needed to keep the operation up to capacity.

Finishing was done by a Lakewood finishing machine. Even at the rate of progress of 150 ft. an hour the machine was able to go over each area three times as required by the state specifications. A Flex-Plane machine installed premolded center joint. Night operations were conducted when necessary, and for this purpose the contractor used a Kohler generator mounted on a Ford truck, and six Crouse-Hinds floodlights.

Subgrading equipment on this job included one Austin-Western 12-ft. blade grader for rough grading, one Austin-Western scarifier, one Adams 8-ft. blade grader, two Perry automatic fresnoes, one Lakewood subgrader, two Caterpillar 60 tractors, one Caterpillar 30 tractor, two Caterpillar 20 tractors and one Fordson roller with concrete-filled wheels. Paving equipment included two Koehring 27-E pavers each with a subgrade planer attached, one Lakewood finishing machine, 7,000 ft. of Lakewood Duo-Rail forms, 150 ft. of Duo-Rail, one Freeman turntable, one Flex-Plane machine and other small finishing tools.

In charge of the job for Hoeffken Bros. Construction Co. were Albert C. Hoeffken, Hubert H. Hoeffken and Edward P. Hoeffken. M. F. Curran was in charge for M. E. Gillioz. Under T. H. Cutler, chief engineer, and H. P. Moberly, division engineer, of the Missouri State



Lighting Unit for Night Operations

Highway Commission, were W. H. Burgwin and N. H. Buss, division construction engineers, and J. T. Baugher and J. R. Parker, project engineers.

Increased Attendance at Purdue Road School

More than 700 men concerned with the building and maintenance of highways and streets in Indiana attended the 17th annual road school held January 19 to 23 at Purdue University under the auspices of the Engineering Extension department and the School of Civil Engineering in cooperation with the State Highway Commission, County Highway Superintendents' Association, County Surveyors' and Engineers' Association and Highway Materials and Equipment Association. This attendance was more than 100 higher than any previous year. The enrolment included county highway superintendents and county engineers or surveyors, who are required by law to attend the school; many county or city street commissioners, contractors, material and equipment men and others.

An important feature of the school this year was the road show held in the armory for two days of the school. The latest developments in paving and other highway materials, new trucks, tractors, graders, snow plows and other items of interest to engineers and contractors were shown.

The problems of particular interest to the highway group were discussed by speakers of state and national reputation, with a number of specialists in one field or another, not only from Purdue but also from other states and from over the state as the speakers. The school was in charge of Prof. Ben Petty, head of the highway work in the School of Civil Engineering, and Prof. W. A. Knapp, assistant director of engineering extension. Besides these two staff members, a number of Purdue graduates now connected with the various cooperating agencies took an active part in the program and the carrying through of the different features, making the school the most successful ever held.

—#—
SANDING SLIPPERY STREETS.—Steep streets in San Francisco are sanded as a corrective of the dangerous slippery condition caused by rain falling on the greasy surfaces. Sand is distributed by a home-made spreader. Streets are flushed daily for the removal of grease.



Cement-Hauling Trucks and Batch Charging Platform

Grading on the Rocky Mountain National Park Scenic Highway with a 1 1/4-Yd. Shovel



Portion of Completed Road

THE award in September, 1930, to L. T. Lawler, Butte, Mont., of a contract for the grading of 10 miles on the west-side section of the new Fall River Road in Rocky Mountain National Park, Colorado, at a price of \$437,178 completes the government plans for the new 27-mile scenic highway from Estes Park to the Colorado River. The contract for the east-side section was let in September, 1929, to W. A. Colt & Sons, Los

Grading a COLORADO Mountain Road

Animas, Colo. This calls for the grading of 17 miles of mountain roadway at a price of \$390,000.

27-Mile Road to Cost over \$1,000,000.—The entire road when finished will be 27 miles long, will cost over \$1,000,000 and will be one of the highest continuous above-timber-line drives in the world. The Lawler section runs from Fall River pass to the Colorado River; the W. A. Colt section from Deer Ridge to Fall River pass. The old or present road goes over the Fall River pass (El. 11,797) up 16 switchbacks and down over Milner pass (El. 10,759) which is the continental divide. In the winter and spring months, even up through June, this road is often impassable. Snow drifts 20 to 25 ft. high are not uncommon. A power shovel is required to clear the drifts, and dynamite is resorted to at times to break up frozen snow and ice.

The new road is designed to get away from excessive drifting as well as to afford an easier ascent and greater safety and to supply a scenic route of unparalleled beauty. The greatest grade will be 7 per cent. The roadway will be 25 ft. on the straight sections, and 28 ft. on curves, banked 3 ft.

The Route over the East-Side Section.—Approaching the W. A. Colt section of the job, one leaves Estes Park on the High Drive Road to the start of the new road at Deer Ridge. From here it follows up Hidden valley, requiring only two switchbacks to reach the timber line at an elevation of 11,500 ft. Going around a third switchback, the new road follows along the top of the Ute Trail ridge, giving a wonderful view of both the Big

Thompson River and Fall River valleys. For the first time tourists will be able to see Iceberg Lake without an arduous climb up a foot trail.

Work on East-Side Section.—The total job calls for grading requiring 284,000 cu. yd. of general excavation, most of which is through tough rock as indicated by the accompanying pictures, which show the typical excavating conditions. The job includes: clearing, 70 acres; grubbing, 50 acres; unclassified excavation in two types, 284,000 cu. yd.; structure excavation, 4,000 cu. yd.; overhaul 77,000 sta.-yd.; finishing, 17.2 miles; Class B concrete, 144 cu. yd.; cement rubble masonry, 700 cu. yd.; hand-laid rock embankment, 4,500 cu. yd.

W. A. Colt & Sons are using five shovels to handle the job: Three Lorain 75's of $1\frac{1}{4}$ -yd. capacity, a 1-yd. Lorain 55 and one Thew Type 00 of $\frac{3}{4}$ -yd. capacity. The biggest cut on the job is 56 ft.; the highest fill about 80 ft. The job is being worked from both ends, all shovels working two shifts a day. In October about 6 miles still remained before the shovels would meet. The job was started October, 1929, and is scheduled to be finished in October of 1931, a considerable feat when it is remembered that 5 months a year is the maximum duration of operations.

Construction Feature.—Scattered along the new road are several camps maintained by W. A. Colt & Sons. Perched on the narrow ledges carved out by the shovels, the camps look out over magnificent scenery as shown on several of the attached views. In building the road much attention is being given to preserving all the natural beauty. The illustration shows the use of timber cribbing to preserve the rock pinnacles. About 5,000 yd. of rock wall will have to be constructed as a safety measure because of the vertical hillside. Great care must be exer-



View Showing Switchbacks; Picture Taken near Timber Line at El. 11,000

cised to prevent any large boulders rolling down the hill and destroying the large pines, rock pinnacles, etc.

Part of the material is cast over the side, the rock wall built about 100 ft. down the slope, preventing an excess roll to the spoil and aiding in building a fill for the outside edge of the road. This slope is then hand-trimmed and landscaped to give the same appearance as the mountainside below the road. At other spots, Ford trucks are used to haul the dirt to the nearest fill, usually three or four of these being employed with each shovel.

This road, when finished, will be one of the longest roads in the world above 10,000 ft. elevation. After the completion of the grading, the federal government will spend over \$250,000 to surface and oil the roadbed.

The entire product is under the direct personal supervision of the U. S. Bureau of Public Roads with A. F. Palen as district engineer at Denver, Colo. Horace M. Albright, park director, and Edmund B. Rogers, superintendent of parks, are largely responsible for planning this mountain road and are now in charge of execution of the work.

ROADSIDE BEAUTIFICATION CONTESTS IN MISSOURI.—In 1929 a roadside beautification contest was sponsored by the State Highway Department of Missouri. As a result of this contest six certificates of merit were given to six communities having made the greatest progress in 1929 in roadside beautification. In 1930 the department again sponsored a roadside beautification contest. One thousand dollars, in five prizes, was provided by the Missouri companies interested in furthering a more beautiful Missouri.



Timber Protection To Save Pinnacles and Preserve the Natural Beauty



First St., N. E., Massillon, Ohio,
before and after the Worn Brick
Pavement was Resurfaced with
Sheet Asphalt



Resurfacing OLD BRICK PAVING with Sheet Asphalt

DURING the past seven years, the city of Massillon, Ohio, has resurfaced approximately 62,000 sq. yd. of old brick streets with sheet asphalt. These streets were originally paved, some of them as far back as 30 years, with locally manufactured vitrified brick, sand-filled and laid on a gravel base. These old pavements, laid without concrete foundation, for horse-and-buggy days, have lost their original contour. In most cases, whatever crown they were originally laid with had disappeared and the surface had become full of depressions and ridges. It is only fair to say that the brick themselves showed very few fractures from the shifting of the pavement. There is no doubt that had these same brick streets been laid on the kind of base and with the filler used in modern brick street construction, they would be in good shape, even now.

In doing the resurfacing, we first redressed and reset the existing curb, or put in new curb to get straight, even lines and grades that would carry the surface water to the nearest storm-water inlet. We also replaced the old-fashioned square corners at street intersections with 16-ft. radius granite circle curb.

Our practice permitted of a 0.5 per cent minimum grade for gutter drainage and a finished curb exposure of from 4½-in. minimum to 8-in. maximum. We figured our finished crown elevation above the finished gutter line by the formula $C=W/8$, W being the width of the roadway in feet between curbs; C is expressed in inches. At a street intersection, where no valley gutters were used, W was the distance from face to face of radius circles measured diagonally across the intersection.

The next step was to bring the street castings up to



Fig. 1—Chalking Curb with Carpenter's Chalk-Line



Fig. 2—Raking Top Course Preparatory to Luting

By C. E. RICE

City Engineer, Massillon, Ohio

their new crown grade. After this, the new finished gutter line was marked on the face of the curb at 25-ft. intervals by the field party. The brick over all service cuts for sewer, water, etc., where we questioned their being solid underneath, were removed. In all places where observations showed any tendency of the street surface to settle, due to old trenches, winter springs or other causes, the brick were removed and a 6-in. thickness of standard concrete paving base was placed in such patches. In fact, we made sure that the brick left in the street were solidly bedded and all other places provided with a 6-in. thickness of concrete base.

All depressions in the pavement below a line 3 in. from the finished surface were filled with asphalt binder and if this happened to be over 3 in. in thickness, it was required to be placed in two layers, rolled separately, in order to obtain a maximum compression. The binder course we



Fig. 3—Operator with 7-Ft. Lute

used was made up of crushed limestone, lake sand and asphalt cement running in the following average weights respectively to a box of finished mixture: 850 lb., 100 lb. and 50 lb. This binder course was finished to a line 1½ in. below the finished paving surface.

We have found that on account of the variance in amount of binder laid on old rough streets we obtain best results by taking bids and paying the contractor for this material per ton in place, rather than per square yard. Each driver, as he comes on a job with his load of binder, has to present to our inspector a scale slip for his load before he is allowed to dump any part of it. Our experience has shown that on all our resurfacing work, we have averaged about 175 to 180 lb. of asphalt binder to the square yard of finished work, compared with 150 lb. where we do new work and have a new concrete base to work on.

Before the top was laid, the finished curb line was chalked with an ordinary carpenter's chalk-line, between



Fig. 4—Rollers in Operation after Dusting



Fig. 5—Applying Straightedge during Rolling

the marks set by the field party, mentioned above. Figure 1 shows this work being done.

Figure 2 shows the top course being raked preparatory to the use of the lute. The lute used on this work had a blade about 7 ft. in length and was manned by an experienced lute operator. Figure 3 shows the use of this lute. We used lake sand, limestone dust and asphalt cement for our top wearing course, mixed in the following proportions respectively per box: 770 lb., 130 lb. and 100 lb. The penetration of the asphalt cement used was 45 to 50. The top course was 1½ in. thick after rolling.

Our rolling was done with a 6 and a 10-ton roller working parallel first with one curb then with the other, toward the center-line of the street. After this, the roller was run diagonally across the street until a thorough compaction had taken place.

Loads leaving the plant averaged 350 deg. F. and were covered with a tarpaulin during transportation to the



Fig. 6—Detecting Unevenness with Bumpometer

street, to keep radiation loss of heat at a minimum. We did not allow top to be laid when the temperature of the air was below 40 deg. F. A back man was required to watch and fix honeycomb spots and trim up around man-hole castings, valve boxes, etc., before the rolling was completed. The dust man followed, sweeping in portland cement before the final rolling. Figure 4 shows the rollers in operation after the dust had been swept on the surface. As we required that no depressions or humps greater than $\frac{1}{4}$ in. in a 16-ft. length of street, longitudinal to the center-line of the street, should appear in the final work, a 16-ft. straightedge was used very carefully while the rolling was in progress. Figure 5 shows the use of this instrument.

After the work was completed, a bumpometer, shown in Fig. 6, was used. This detected any excess or unevenness in our finished work. This instrument was set to

ring at each place where a variation of $\frac{1}{4}$ in. in a 16-ft. length from the straight line appeared. The thorough use of these instruments is recommended on every sheet-asphalt job, for detecting spots where special attention should be given before the rolling is completed. We sealed all gutters along the curb by pouring asphaltic cement on the street and running a heating iron along next to the curb after the rolling was completed.

We found that the base contraction cracks which are transmitted through the surface of a new asphalt street during the first winter have not appeared in our resurfacing jobs. We have our original asphalt resurfacing job, put down in 1923, without a single surface crack in it today.

The resurfacing work in this city has been done by Urban Bros., of Massillon, assisted by the General Asphalt Paving Co., of Canton, Ohio. The latter firm did all the hot application work, using Texaco asphalt. Asphalt inspection, both on the street and at the plant, was handled by the H. C. Nutting Co., of Cincinnati, Ohio. The design, drawing of specifications and general supervision of the work were done under the direction of the writer.

Legal Decisions Affecting Highway Contractors

When the Creator made the world he did not stop to equip it with highways and litigation has followed the course of highway construction according to J. F. Ingham, professor of constitutional law and evidence at Dickinson College in a report to the American Road Builders' Association.

Surety Bond.—A case of great interest to contractors and material men is Greene County vs. Southern Surety Company 292 Pa. 304, in which the court decided that the surety company was not responsible for claims made for the labor and material furnished in the construction of a highway by the county. The decision in this case was based principally upon the wording of the bond accompanying the contract, which indicated in the opinion of the supreme court that there was no intention expressed in the bond that it should be for the benefit of any other than the county. The creditors were regarded as third persons, not parties to the contract, and the bond could not inure to their benefit.

Misrepresentation.—Another case involving the contract phase of highway law is that of Jackson vs. State, 205 N. Y. S. 658 in which the withholding of a material fact, amount to a misrepresentation on the part of the state, entitled the contractor to damages.

The state let a contract for the excavation of a portion of a canal. Borings had been made by the state, and in giving the information to the bidders, the material was stated to be of certain kinds and classes, easy to excavate. At the time of the making of the contract the state had other information classifying the material as being a compacted mass of hard-pan, much more expensive to excavate.

The court said: "A party to a contract cannot by misrepresentation of a material fact, induce the other party to the contract to enter into it to his damage, and then protect himself from the legal effect of such misrepresentation by inserting in the contract a clause to the effect that he is not to be held liable for the misrepresentation which induced the other party to enter into the contract. The effect of misrepresentation and

fraud cannot be thus easily avoided. If it could be, the implied covenant of good faith and fair dealing, existing in every contract, would cease to exist."

Labor.—Matters of great import to those interested in the "open shop" theory of labor are those treated in the report of William M. Cannon, Esq., referee, made October 30, 1929, to the U. S. District Court for the Southern District of New York, in the case of Levering and Garrigues Co. vs. Paul J. Morris. Judge Cannon decreed: "That the defendants (members of voluntary labor organization) should be permanently restrained and enjoined from inducing, or attempting to induce, owners, architects or general contractors to let no subcontract to the plaintiffs for the erection of structural iron and steel on buildings now being or to be erected in the Metropolitan District of New York by sending them circulars or other writing stating, threatening, warning or intimating that members of the unions associated with the international may or will refuse to work on buildings upon which plaintiffs have subcontracts or by sympathetic strikes," etc.

Liability for Injuries.—Appeal of the City of Erie, 147 Atl. 58: City overseeing work of sewer contractor was liable for injuries to pedestrian falling into open trench which city failed to properly safeguard. It can not escape liability by placing work in charge of an independent contractor.

McCrary Company vs. White Coal Power Company, 35 Fed. (2d) 142: Contractor constructing water works for town on cost plus basis, and having supervision over work, is an independent contractor and the town is not liable for his negligence.

Defects in Design and Workmanship.—Tooker vs. Lonky, 147, Atl. 445: Independent contractor is liable in exoneration of employer only for defects in doing work, not for defect in design. (Excavations causing collapse of adjoining building.)

Falkinburg vs. Venango Township, 147 Atl. 62: There is a rebuttable presumption that the township supervisors have properly performed their duties and taken steps necessary to give validity to their official acts.

Power to Contract.—Foresman vs. Gregg Township, 147 Atl. 64: A township contract for the purchase of road machinery must be approved by an officer of the state highway department before it is actually entered into. Contract was invalid because approval was not obtained and, therefore, could not be enforced. One dealing with officials of a quasi-municipality must take notice of its limited powers to contract.

Strauss and Company vs. Berman, 147 Atl. 85: One who signs acceptance of a proposition submitted to him individually by a contractor is held individually liable therefor although he wrote in the name of the corporation.

Fidelity and Deposit Company vs. Wheeler, 34 Fed. (2d) 892: Agreement by creditor to hold surety harmless from all claims arising under surety bond in consideration of surety paying creditor stipulated sum and waiving all claims for reimbursement is valid and enforceable, and the one promise is consideration for the other.

Completion Within Specified Time.—Layne-Bowler Company vs. Glenwood, 34 Fed. (2d) 889: Where the contract set no date for final completion, but the bond stipulated against suit on the contract after a date certain the two will be construed together, and the contractor who breaches the contract is estopped to claim the right to continue work after such date.

Notes on Recent Street Paving in Chicago

By H. J. FIXMER

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THIS paper will describe briefly some of the recent major Chicago street paving projects designed and constructed under the supervision of the writer. Certain innovations and ideas will be described which should prove of interest to city engineers and others connected with paving work.

Canal St.—Canal St., from Madison St. to Lake St., was paved in October, 1929, together with part of Washington Blvd. from Canal St. to the viaduct west of the river. This work was done by private contract by the R. F. Conway Co. for the three owners of the entire frontage, Butler Bros., the Chicago Daily News Co. and the Chicago & North Western Ry. The pavement consisted of an 8-in. concrete base with 1½-in. top on a binder varying from 2-in. to over 6-in. The asphalt was laid quite "hard" owing to the heavy traffic, both in volume and weight.

The interesting feature in connection with this work was the layout of the intersection of Canal St. and Washington Blvd. Because of difference in elevation of the curbs, both streets required an eccentric crown. This with a vertical curve to meet the slope cast of the crown on Canal St., made a complicated layout, particularly for setting the many utility covers found at this intersection. In order to have the covers, which numbered about 20, set properly before concreting, a contour plan of the intersection was made with contours 0.1 ft. apart. Having prepared the contour plan the covers were located thereon. With the elevations easily determined from this plan the covers were set by rod and level.

N. LaSalle St.—N. LaSalle St., from Washington Blvd. to Ohio St., was completed in December, 1930. The part south of the river was finished in 1928. The part from Kinzie St. to Ohio St. was paved with an 86-ft. roadway. The street was 80 ft. wide and was widened to 120 ft. by taking 20 ft. from each side. Most of the buildings in the way of improvement were removed by the owners or cut off to the new line. Those remaining were cut off to the new street line by the paving contractor. This work was done under special assessment by J. A. McGarry & Co. About 20 per cent of the sidewalks, 17 ft. in width, were constructed on fill and the balance were of vault construction composed of channels, I-beams and cast-iron columns with heavy concrete retaining walls 12 ft. in height.

The vault walks had a ½-in. expansion joint every 40 ft., formed by two channels back-to-back with a flexible copper plate over the flanges at the bottom and the space filled with asphalt. At driveways the walk was reinforced by increasing the number of cross-beams and iron columns. The pavement was 10 in. thick, composed of concrete laid in two courses—one 7 in. thick of gravel aggregate and the top course 3 in. thick of granite aggregate. The specifications called for a mixing period of 2 minutes and a 1:2:3½ mix. Because of the cold weather

and extreme importance of opening this street to traffic, 8 bags of cement were used to a cubic yard of concrete, making a rich mix of about 1:1½:2½. On the intersections and part laid in December, Prestolith Velo cement was used. Test cylinders were made and cured in the open and tested at 3 and 7 days. The Velo cement concrete tested 2,630 lb. at 3 days and 4,000 lb. at 7 days. The eight-bag-mix concrete tested 2,320 lb. at 3 days and 3,400 lb. at 7 days.

In connection with the use of quick-setting or high-early-strength cement at street intersections to enable early use of the crossing by the busy cross street, the idea occurred to the writer that in the future consideration should be given to this matter in planning improvements where the traffic is heavy. It appears both logical and wise to build intersections or street crossings, at least between the curb lines of both streets, stronger than the street proper. Either a thicker base or pavement should be planned, or a stronger structure available for early use secured by using a richer mix or a high-early-strength cement. I am of the opinion that country roads as well as streets should be so planned, and it certainly could be shown in any special assessment proceeding, that the intersection should be stronger, due to the extra traffic which it must carry.

The pavement was laid in four panels 21½ ft. wide, with 5/8-in. felt joints along the center-line, quarter-line and the face of the vault. Transverse joints were spaced about 30 ft. apart and were staggered wherever practicable. Staggering the joints, especially where the slab is entirely surrounded by a felt joint, I consider good practice in that there are only two slab corners instead of four at any point. Where hand finishing is done, as in this case, there is less chance of unevenness at the joint.

N. LaSalle St., from Ohio St. to N. Clark St. (at Lincoln Park), was paved by the White Paving Co. under special assessment. This street was originally 80 ft. wide and was widened to 108 ft. by taking 14 ft. off of each side, except a small part at the north end where 28 ft. was taken off of the east side.

The roadway is 74 ft. wide, consisting of a 3½-in. asphalt top on an 8-in. concrete base. This street is about 1½ miles long and, because of its importance as a direct artery into the loop, extraordinary effort was made to complete it. Fortunately the weather was lenient, and we were able to complete it except for a narrow strip about 250 ft. long near the north end where a building was not removed in time. Many of the buildings have not been moved back, but the paving was completed notwithstanding. As the roadway is 74 ft. and the street was 80 ft. between buildings, the entire area 80 ft. wide was graded, removing all walks and other obstructions. A monolithic curb and walk was built 2 ft. wide as part of the sidewalk contract; the remainder, 15 ft. wide, was built where the space was vacated, and elsewhere left out

until the buildings are removed this year. The subgrade for about 70 per cent of the job was sand and much of the cutting was used to fill vaults, trenches, etc. Three concrete mixers, abreast, were used, laying an average of about 5,000 sq. yd. of 8-in. concrete a day. A 12x8-in. gutter was used in front of the monolithic curb and walk. This gutter was laid with a 2x1½-in. recess to engage the concrete base to withstand settlement. Particular pains were taken to plan the crown for a through street. No curb-corner catch-basins were used, and a very flat crown across intersecting streets at the curb lines eliminated any bump, as is commonly in evidence on most city streets.

N. Harlem Ave.—N. Harlem Ave., from North Ave. north, a distance of 1¼ miles including intersection returns, was paved in September, 1930. The center 20 ft. of this street had been paved by Cook County as a state-aid road. The west 10 ft. was paved by the village of Elmwood Park and the east 10 ft. by the city of Chicago, under special assessment, making a 40-ft. roadway. The Marquette Construction Co. had the contract. This street was started after Labor day and, after allowing the concrete pavement to set not less than 10 days before admitting traffic, was thrown open to traffic throughout its length before Oct. 1, less than a month after starting.

This pavement was one-course concrete, 1:2:3½ mix, 10-in. thick, laid on a rolled subgrade with ¼-in. bars spaced 3 ft. apart to anchor the battered curb. The curb was placed while the pavement was curing, sidewalks were repaired and joints along curb and adjacent to the old slab in place, asphalted. This was record work considering the delay occasioned by necessary sewer work and utility adjustments.

Austin Ave.—Austin Ave., from Michigan Ave. east, in front of the Tribune tower, was paved by J. A. Rose & Co. in May, 1930. This was a 10-in., two-course concrete pavement. This mix was 1:2:3½, using Velo cement throughout. This high-early-strength cement was used to enable the Tribune Co. to use the street within 36 to 48 hours after laying, to haul and unload heavy trucks carrying rolls of newsprint. At 24 hours this concrete tested 2,100 lb. per sq. in. and at 48 hours, 3,260 lb. per sq. in.

N. Ashland Ave.—N. Ashland Ave., from Lake St. to Division St., was paved by the Chicago Construction Co., and from Division St. to Cortland St. was paved by the J. M. Bransfield Co., a total length of about 2¼ miles. This street was widened from 66 ft. to 100 ft. by taking 17 ft. off of each side, and paved with a 70-ft. roadway, except that part between Division St. and Milwaukee Ave., which was paved 90 ft. wide. This work was started in the fall and was rushed to give employment and have the street open for use before winter set in. The pavement consisted of an 8-in. concrete base, 1½-in. mortar cushion and 5-in. granite blocks filled with a 1:1 grout filler. About 70 per cent of the old granite blocks were salvaged and relaid lengthwise along the curb to form a parking space from 6 to 7 ft. wide. During December when it was too cold to use a grout filler the joints were filled with pea gravel and hot asphalt. This street, being a through street, was planned with no corner basins and with crosswalks flush with the curb at intersecting streets other than car-line streets.

The granite crown at intersection of the crown of the cross-streets with the curb lines of Ashland Ave. had a rise of but 5 in. in 33 ft. All alley returns and street returns, from the curb line to 15 ft. back of the new street line, were paved with asphalt on the old concrete base brought to grade with additional concrete or binder. This saved considerable money over using granite where the

traffic was light, and provided a smoother surface for pedestrians. Considerable underground work had to be constructed and, as this could not be done until the buildings were removed, the contractor was obliged to move frequently and work where the area was cleared.

A monolithic curb and walk 15 ft. wide was laid on fill prior to laying the pavement. Where time and weather did not permit the full walk being laid, a 7-ft. walk with curb was laid. An asphalt mastic filler I consider superior to the grout filler for both new and old block, but as the ordinance called for a grout filler it was decided to use this filler. In order to speed up the laying of the granite blocks it was necessary to secure experienced pavers from various cities. On one day 2,750 sq. yd. of granite blocks were laid complete.

General.—On residence streets the only types of pavement laid are asphalt 3½ in. thick on a 6 or 8-in. concrete base and concrete, generally of two courses—the bottom course 6 in. thick of gravel or stone aggregate, and the top course 2 in. thick of granite aggregate. Some vibro-lithic concrete 8 in. thick was laid. On streets laid by private contract more latitude is given in experimenting with new ideas.

One street was laid 10 in. thick with mat reinforcement 2 in. below the top and 2 in. above the bottom, with a battered curb anchored to the pavement with 5/8-in. bars, 30 in. long spaced 3 ft. apart. On other streets a Heltzel formed center joint was used with dowel bars across all joints and into the curb and gutter.

All concrete streets are finished with a belt after rolling, covered with burlap and cured with calcium chloride. Traffic is kept off from 10 days to three weeks, depending on the temperature. A few streets are being resurfaced with asphalt or asphaltic concrete. Practically all alleys are built of 1:2½:4 concrete, 7 in. thick. Granite blocks on 1½-in. cushion on 8-in. concrete and concrete 10 in. thick are used on industrial or heavy-traffic streets.

No plant-mixed concrete is used. All material is proportioned at the yard, delivered in batch trucks, mixed not less than 1 minute and deposited directly on the cleared subgrade. More attention is being given to regulating the amount of water used. Since the strength of the concrete is affected by the amount of water used, I am of the opinion that the water should be carefully restricted, and increased workability, if desired, secured by increasing the time of mixing. I think we are approaching the time when all material will be specified by weight instead of by volume as at present. The weight of cement, dry sand, dry graded aggregate and water per cubic yard (or square yard of a given thickness) required for concrete of definite strengths, can now be specified. The cost of cutting and filling is becoming more expensive, and where this material is hauled in large trucks, I believe it could be paid for on a poundage basis. Thus, instead of a bid for cutting or filling in place at so much per cubic yard, a bid per ton or per 1,000 lb. could be required. The city is almost completely paved to the city limits, and practically all new work consists of widening and repaving old streets in the more settled part of the city.

Acknowledgment.—Mr. Fixmer's paper was read on Jan. 30 before the annual meeting of the Illinois Society of Engineers, held at Rockford, Ill.

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NON-SKID TREATMENT FOR ASPHALTIC CONCRETE.—The State Highway Department of South Carolina has developed a non-skid treatment on asphaltic concrete roads. It consists of the application of 1-10 gal. per sq. yd. of kerosene, which is allowed to penetrate or cut-back the fat surface, after which new chips are rolled into the road.

Reconditioning Short-Span Steel Bridges by Welding

WELDING is practically a new subject to many county engineers, consequently they have not made use of it very generally in their work. In county maintenance, for instance, there are numerous occasions when welding can be used to good advantage. The many possibilities which welding affords in reconditioning steel bridges formed the subject of a special report prepared for the County Highway Officials' division of the American Road Builders' Association and presented at the recent convention of the association. The report was prepared by Charles B. Danneberg, consulting engineer, Wilmington, Del., and the matter following is taken from it.

As a result of the many tidal inlets in Delaware, there are many bridges of all sizes, shapes and descriptions. Hundreds of these are of the low truss type of two-rivet web member connections, 9 and 10-in. suspended floorbeams and 5 and 6-in. stringers, built three to four decades ago, with many erected even before that, long before the advent of the automobile and the subsequent heavy truck traffic of today. These bridges are still in service in defiance of all figures to the contrary, and if properly taken care of will continue to carry traffic for some time to come, even though at times they are greatly overloaded. However, such bridges have been mostly removed from the main arteries and are being shifted here and there over the laterals to replace old timber bridges, but they have a great many weak spots which may be materially strengthened so that the service of these bridges may be considerably prolonged under the terrific impact of heavy modern traffic.

To attempt repairs by the old methods in vogue for approximately half a century is not only costly but exasperatingly slow in this era, and in many cases practically impossible on account of the antiquated type of structural details. Therefore, little or nothing can be

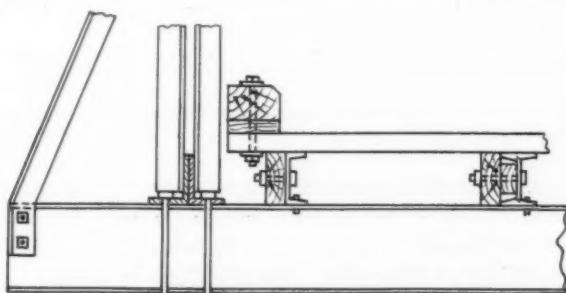


Fig. 1—Detail of Low Truss Spans Showing Floorbeams Hung from Flange of Chord by Means of Through-Bolts

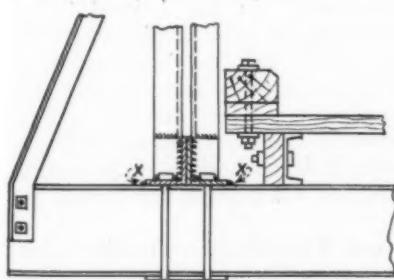


Fig. 2—Excessive Deformation of Chord Angles Checked by Welding

done in the way of effectively strengthening or reinforcing many of these old bridges when we think of repairs in terms of field drilling, bolting and riveting. Most all of these "infirmities of old age," so to speak, may be easily and effectively cured or arrested by means of arc welding.

Reinforcing Low Truss Spans.—To begin with, take one of those familiar low truss spans with the floorbeams hung from the bottom flanges by means of through-bolts from the bottom of the beam to the outstanding legs of the angles. In details of this type, illustrated in Fig. 1, the heavy loads have in some cases badly bent the angles for some distance either side of the floorbeam, and in some instances the loading has been severe enough to cause rupture of the angles. Such deformation may be checked by means of welding stiffener plates to the faces of the chord angles at the points of best advantage and thus taking the bending out of the outstanding legs by transferring the floorbeam reaction directly to the web legs of the chord angles. (See Fig. 2.)

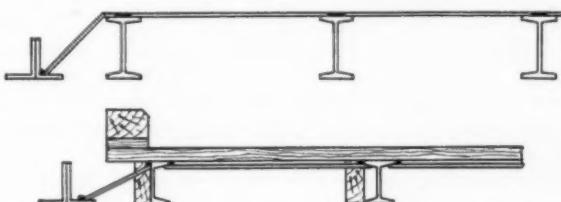


Fig. 3 (above)—Restraint of Top Flanges of Stringers by Continuous Tie Bar. Fig. 4 (below)—Restraint by Welding Short Pieces of Tie Bar

The bolts may be very badly rusted from lack of attention; and while the welder is at the job, it takes but a few minutes to weld the toes of the angles to the floorbeam flange as marked at X in Fig. 2. Six inches of $\frac{3}{8}$ -in. fillet weld would be good for 18,000 lb. in shear and would require only ten minutes to do. The bolts would then be of only secondary consideration.

Another point of structural importance is the restraint of the top flanges of the stringers which are generally only 3 to 4 in. wide and dependent on the flooring for lateral restraint. But rotted planking and nailers are not of much account in providing sufficient lateral stiffness; therefore, when the bridge is being replanked, it is very easy to weld a $1\frac{1}{2} \times \frac{1}{4}$ in. flat across the top flanges of the stringers and bend down the ends to connect them to the bottom chords of the trusses. Just how many of these are required per panel depends on the intensity of compressive stress in the stringers, but to get their full resistance, it is well to limit the spacing of the ties to a maximum of 15 times the width of the stringer flanges. Thus a 4-in. flange should be restrained every 60 in. to obtain full resistance of the stringer.

The tie bars may interfere somewhat with the planking when it is laid directly on the steel, but a sharp adz can take care of that. However, with a little more labor on the tie bars this difficulty in laying the planking may be eliminated by using short pieces of tie bar between the

stringers and welding them as shown in Fig. 4. If spiking strips are used on top of the stringers, the continuous tie bar as shown in Fig. 3 is preferable.

While the $1\frac{1}{2} \times \frac{1}{4}$ -in. welds are good for about 3,000 lbs. each, which is at least six times as much as required for restraint of good-sized stringers, it takes less than five minutes for the average welder to run in 3 in. of $\frac{1}{4}$ -in. fillet and it is a better plan to have too much than not enough, particularly in out-of-the-way places which are so liable to be neglected in the painting. Keep in mind that these ties should be securely connected to the trusses as the resistance of the chord angles is required to restrain the stringers.

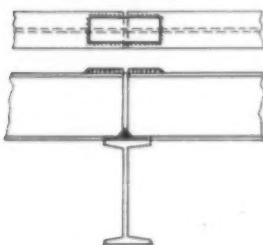


Fig. 5—Stringers Welded to Floorbeam; Continuity of Stringers Effected by Welding

If the stringer connections are loose, a couple of fillet welds, say $1\frac{1}{2} \times \frac{1}{4}$ -in., to the top flange of the floorbeams will be equivalent to the shearing resistance of two $\frac{3}{8}$ -in. diameter bolts in holding the stringers in place. (See Fig. 5.)

Increasing Resistance of Stringers.—When the stringers are not continuous over the floorbeams, their resistance can be increased at least 25 to 50 per cent by effecting continuity of the section at the points of support, as in Fig. 5. Say, for example, the stringers were 8-in. I-beams on a 14-ft. simple span with the flanges unrestrained; the permissible safe uniform load would be equal to about 7,200 lbs.

Make the stringers continuous for the full length of the bridge, properly restrain the compression flanges, and the permissible uniform load of the end span with a moment factor of $\frac{WL}{10}$ would be equal to about 13,500 lb. at 16,000 lb. unit bending stress, thus increasing the safe resistance of the stringers approximately 88 per cent. If the bending moment at the point of support is considered as equal to 19,000 ft.-lb. (the full amount of resistance at 16,000-lb. unit bending stress), then the number of linear inches of $\frac{3}{8}$ -in. fillet weld required to effect continuity would be equal to $\frac{19,000 \times 12}{8 \times 3,000} = 9.5$ in., required on both top and bottom flanges each side of the center-line of splice.

When the floorbeam flange is not wide enough to get that amount of weld along the flange of the stringer, there are several methods that may be employed to that end. One is to supplement the fillet welds on the stringer flange to the floorbeam flange by rivet welds, which are welds made by filling holes with weld metal. They are stronger than ordinary riveting, because the welding

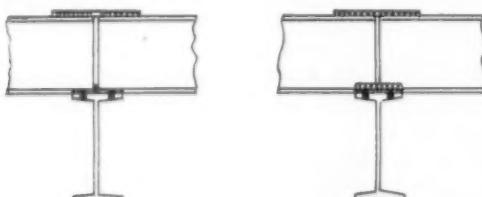


Fig. 6—Fillet Welds on Lower Stringer Flange Supplemented by Rivet Welds (left) and Same Connection Supplemented by Short Bars on Top of Flange

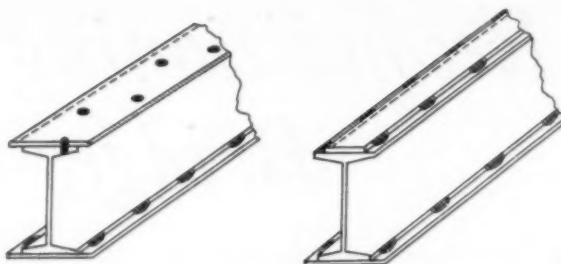


Fig. 7—Cover Plates Welded to Flanges of Floorbeams or Stringers

metal completely fills the holes and is integral with the base metals themselves. There is no possibility of a rivet-welded joint ever working loose.

Another method of effecting continuity of the bottom flanges of stringers at their points of support when sufficient fillet weld cannot be run in on the floorbeam flange is to supplement that weld with two short bars on the top of the bottom flange of the stringer as shown in Fig. 6.

The top flanges of the stringers are generally connected with a splice plate with a width about an inch less than the width of the stringer flange, and a length sufficient to run in the number of linear inches of weld required. The thickness of the splice plate would depend on the amount of flange stress, but to develop the 8-in. I-beam, as previously mentioned, with 19,000 ft.-lb. resistance at 16,000-lb. unit stress, would require a $3 \times \frac{5}{8}$ -in. plate about 11 in. long, allowing about $\frac{1}{2}$ in. for each crater of the welds and $\frac{1}{2}$ in. between the ends of the stringers, and counting on $\frac{3}{8}$ -in. fillet welds at 3,000 lbs. per lin. in. A good welder could make this splice complete in less than an hour.

To build up the section of the beam to make a continuous section would require considerably more weld metal and filler metal, and in the tensile area of the splice, it might not be so dependable as the methods herein explained.

Strengthening Floorbeams.—It is a very simple procedure to increase the resistance of floorbeams or stringers by means of cover plates (Fig. 7). To weld a top cover plate on a floorbeam in position when the cover plate is wider than the flange, it will be necessary to avoid overhead fillet welds by the use of the required number

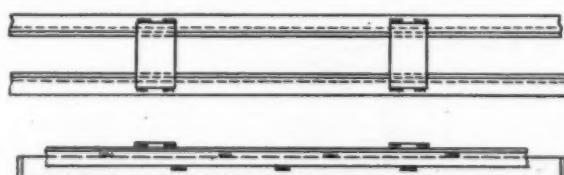


Fig. 8—Bottom-Chord Eye-Bars Reinforced by Welding Angles to Bars and Batten Plates to Angles

of rivet welds to develop the resistance of the additional material. It is better, however, to select, if possible, a cover plate with a width at least 1 in. less than the flange width so that fillet welds may be used in place of rivet welds, which take more time. For the bottom flange, select a plate with a width about an inch greater than the width of the flange and use the required amount of fillet weld to develop the horizontal shear. A distinct saving in this case is that the section is figured for its gross instead of net moment of inertia, as when holes are drilled for rivets or bolts.

Welding the Top-Chord Knee-Brace.—Another point that sometimes needs attention is the connection of the

top-chord knee-brace. It is only efficient when tightly connected, and welding affords the surest and cheapest method of keeping these braces forever tight.

On several of the old pin-connected spans, the end post and top chord may be greatly stiffened by welding the hip joint the full width of the cover plate if no cap plate has been provided.

One of the best uses of welding on the old pin-connected spans, using eye-bars for the bottom chord where the end bottom chords have buckled, due to the wind-load compression being greater than the dead-load tension, is to weld angles on the outside and use batten plates as shown in Fig. 8.

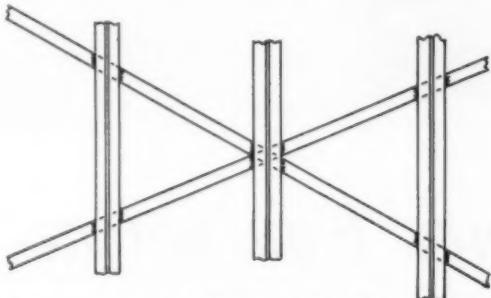


Fig. 9—Bottom-Lateral Rod Bracing Replaced with Flat Bars Welded to Bottom Flanges of Stringers

The best thing to do with loose and insufficient bottom-lateral rod bracing is to replace it with flat bars of equivalent area welded to the bottom flanges of the stringers at all intersections, as shown in Fig. 9, with short tack welds not over an inch or so long. The results are very satisfactory and all the alarming rattle is eliminated.

Restoring Efficiency of Rusted Members.—Rusted members which have lost considerable of their original section may be very easily brought back to their original efficiency by removing the rusted portions and fusing in sufficient weld metal to restore the section or by cutting out the bad places and welding in new material. This is oftentimes found cheaper than supplying a whole new member, particularly so when it might be necessary to close the bridge to traffic in order to replace a whole member.

Another matter of importance in many of these small highway spans is the fact that, while web members of trusses may have sufficient sectional area to meet the requirements of modern traffic, the sections are not developing their full resistance due to their being connected as a general rule with two $\frac{3}{4}$ -in. rivets through one leg, thus creating an eccentricity which reduces the efficiency of the member at least 15 per cent. Weld the outstanding legs to the chord angles and supplement the rivets by sufficient fillet weld properly made, and the joint is stronger than the members themselves. (See Fig. 10.)

A great many bridges have old shaky railing, which makes enough noise to alarm anybody, and the best thing to do is to scrap it and weld on pipe railing or flat bar

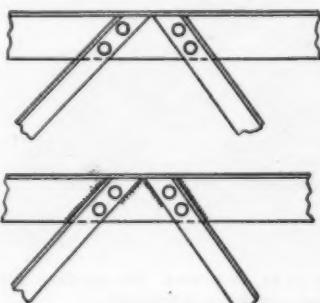


Fig. 10—Web-to-Chord Connection of Small Truss Strengthened by Welding

railing. This is just as efficient, more easily kept painted and much cheaper.

Welding Applied to Floor System.—As a rule, the floor system is the weakest part of the majority of the old steel bridges, but many of the trusses have badly rusted bottom flanges, particularly so at the end bearings, and their resistance is dangerously reduced to but a small percentage of the original value. To shore the floor-beams, burn off the bad portions and weld in new members; this requires but a few hours. In one case, a $6 \times 3\frac{1}{2} \times \frac{3}{8}$ -in. angle 24 ft. $9\frac{1}{2}$ in. long was removed, holes were burned in the new angle to match the old gusset plates and the angle was rivet-welded to the old truss in less than three hours' time, restoring the truss to its full original resistance in a remarkably short time and at very little expense.

Bottom-chord splices may be quickly restored to a greater efficiency than before by arc welding, as the welds are integral with the members thus joined, and the full gross area of the section is therefore available; whereas before, the section may have had probably four holes out of the sectional area.

There are many other places where welding will be found really indispensable in bridge maintenance, particularly so in movable bridges where many mechanical parts break or work loose and shear their connections.



Wages and Working Hours for Iowa Road Contracts

The State Highway Commission of Iowa has adopted the following resolution regarding minimum wages and working hours on primary road projects in that state:

1. That 60 hours per week is, in the judgment of the commission, the maximum number of hours per week in which paving operations should be carried on on primary road paving projects in this state, and contractors on such work are hereby requested to keep their working hours within such limits, provided that in case of emergency, on account of weather conditions or for other good and sufficient reason, the chief engineer or assistant chief engineer may approve working longer hours as may seem advisable.

2. That a general practice of working on paving projects on Sundays is objectionable to the commission, and paving contractors are requested to refrain from working on Sundays, except in cases where rain or other weather conditions have delayed paving operations during the week to such an extent that working on Sunday is necessary to maintain the 60-hour-per-week schedule, provided that the chief engineer or assistant chief engineer may authorize any contractor to work on Sunday, if in their judgment such Sunday work is necessary.

3. That contractors are requested to use Iowa labor as far as possible in carrying on their operations.

4. That in preparing their bids, contractors are requested to base their labor estimates on 40 ct. per hour as the minimum wage, and that contractors will be expected to pay not less than 40 ct. per hour as the minimum wage paid to any of their laborers during the construction of such work.



HIGHWAY EXPENDITURES IN GREAT BRITAIN.—There were 179,286 miles of public roads in Great Britain in 1930, according to the Automotive division of the U. S. Bureau of Foreign and Domestic Commerce. Following are the gross expenditures on roads from public funds during the last three years for which figures are available: 1925-26, \$292,165,910; 1926-27, \$289,745,520; 1927-28, \$289,360,790. The sums expended under grants from the road fund (similar to our federal aid) follow: 1925-26, \$78,723,550; 1926-27, \$82,668,250; 1927-28, \$91,278,410; 1928-29, \$82,863,050; 1929-30, \$96,350,080.



This outfit, consisting of a light tractor with a rotary broom and an 11-in. blower, has reduced the cost of cleaning roads previous to surface treatment 50 per cent

Out of the need for special machines for specific maintenance operations has grown an extensive array of equipment enabling the economical prosecution of this work. The state highway maintenance departments have not been backward in developing and applying new machinery and methods, and the accompanying pictures will testify to the progressiveness of the state of Virginia in this respect.

Virginia Maintenance Equipment



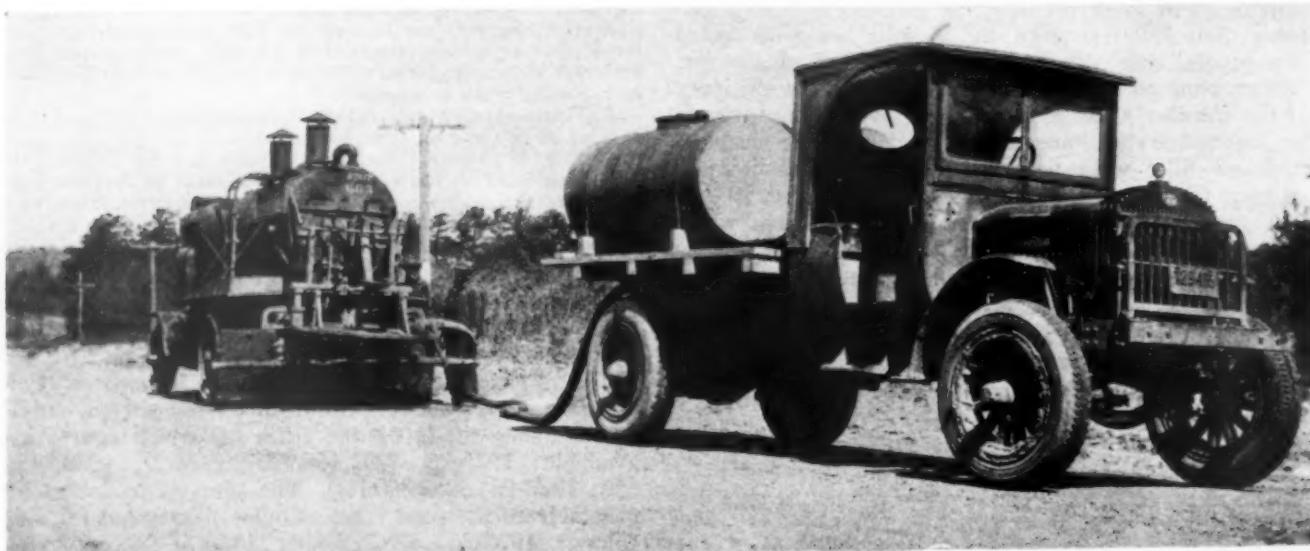
Above—Drag made from stable brooms, used in distributing and smoothing the covering material used on a cold bituminous surface treatment

Pictures from J. J. FORRER

Maintenance Engineer, Virginia State Department of Highways

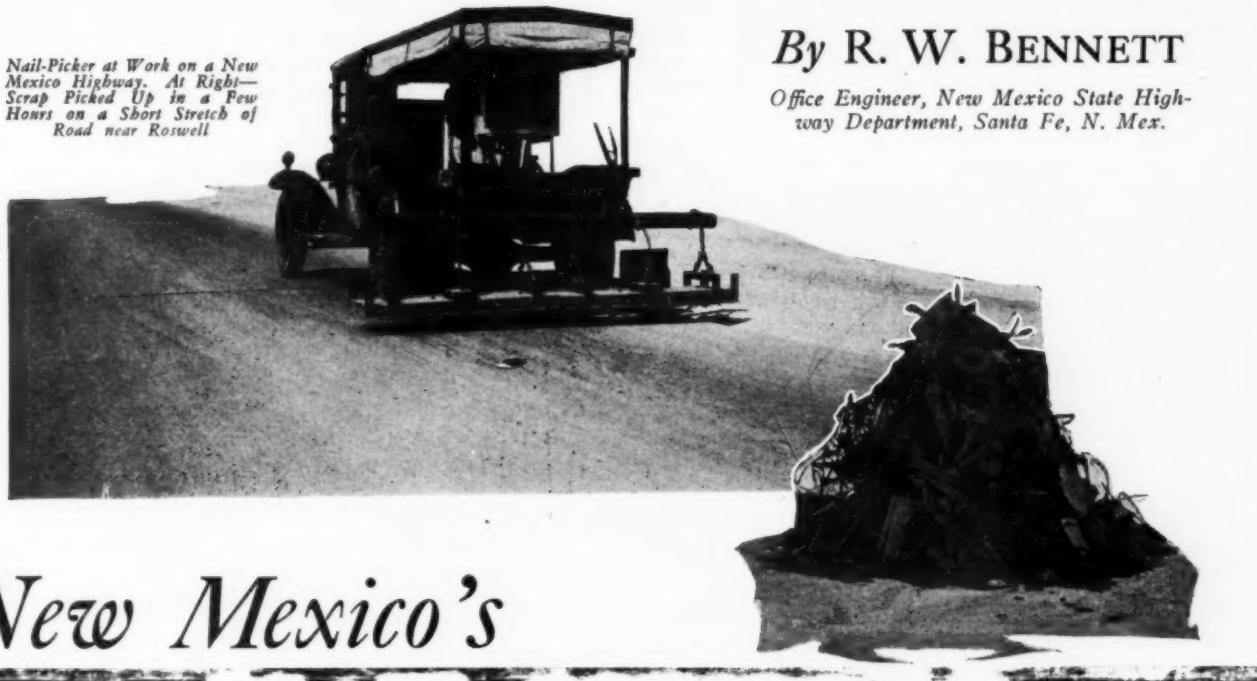


Right—Chip spreaders reduce handling costs and save material



Where hauls on bituminous material are long, separate hauling tanks, mounted on high-speed trucks, are used for loading distributors. By operating this equipment properly, it is possible to keep the application almost continuous

Nail-Picker at Work on a New Mexico Highway. At Right—Scrap Picked Up in a Few Hours on a Short Stretch of Road near Roswell



By R. W. BENNETT

Office Engineer, New Mexico State Highway Department, Santa Fe, N. Mex.

New Mexico's NAIL-PICKERS Save Motorists Money

WHAT, or how much, do New Mexico's magnetic "nail-pickers" or "metal sweepers," five in number, save the motorists traveling the roads of this state? This question is often asked the state highway department and the department's statistician has dug up some facts that are of more than passing interest.

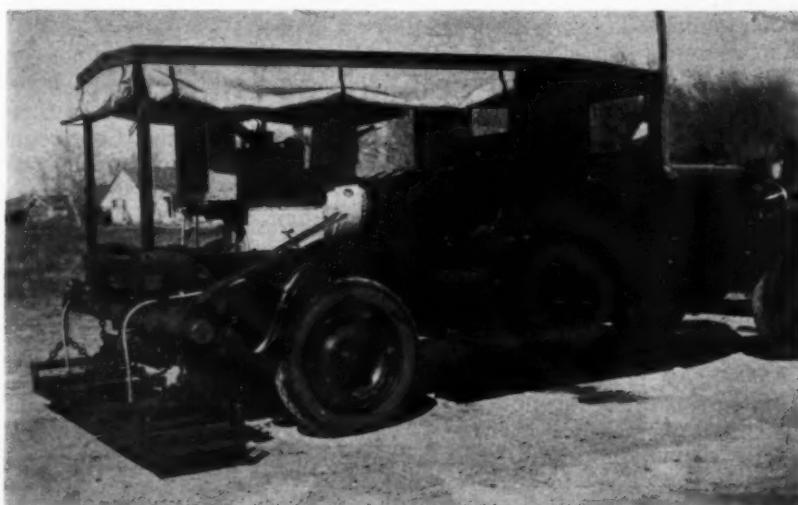
A number of New Mexico state highway department cars selected at random from all over the state were used as a basis of reckoning. From the records of the equipment division it was determined that these cars in traveling a large mileage cost the department \$0.00153 for tire repairs per mile. This was before the inauguration of the nail-picker service. The same cars traveling the same

mileage after the nail-pickers had been put at work on the highways, clearing them of nails, tacks and other puncture menace, cost only \$0.00097 per mile for tire repairs. The average saving per mile therefore has been \$0.00056.

During 1930 there was sold in New Mexico approximately 52,080,000 gal. of gasoline used in pneumatic-tired motor vehicles. Assuming an average performance per gallon of 11 miles, motorists traveled 572,880,000 miles on the roads of the state during 1930. Applying the saving per mile of \$0.00056 to this volume, the total saving to motorists during the year was \$320,812 in tire and tube repairs alone.

This direct saving in cost of operation for tires and tubes is not the only economy, however. The greater service rendered the autoist because of time gained and lack of inconvenience, which is made possible by the nail-pickers' operations, results in a saving which cannot be readily computed in dollars and cents. When it is understood that the highway department's five nail-pickers cost but \$14,000 for operation expenses this year, some idea is gained of the economic return which they paid the motorists traveling on the roads of the state during that period.

A brief description of New Mexico's metal-sweepers or nail-pickers may be of interest. The machine consists of a standard light truck upon which are mounted an electric generator with a 4-cylinder engine for power, magnets and control switches. The engine is equipped with an



Side View of One of the New Mexico Nail-Pickers

oversize radiator and circulating water pump. The generator, driven with a short drive shaft, is a 3-kw. shunt-wound, direct-current machine. Control switches consist of a meter, voltmeter, field rheostat and two 250-volt light bulbs which indicate the current being generated. Two large horizontal magnets, each 4 ft. long, placed end-to-end and constructed of 12-in. I-beams, are suspended from chains at the rear of the machine, 5 or 6 in. from the ground. These magnets cover 8 ft. of roadway on each trip; three trips are therefore required on a 24-ft. road to clean it completely of nails and other metal objects that puncture tires. A switch at the rear of the machine allows the operator to dump his trash wherever found convenient. The magnets are powerful; a 10-ft. grader blade weighing 65 lb. can be lifted 4 in. to the magnets and requires two men to remove it, so tightly does it cling.

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Transporting Explosives in Motor Vehicles

Regulations designed to insure the safest conditions possible in the transportation of explosives in motor vehicles have been drawn up by the United States Bureau of Mines, Department of Commerce, for the guidance of its own employees. The bureau is constantly engaged in the testing and field study of explosives used in mining, and many of its employees are frequently obliged to transport explosives by motor. These regulations have been published in Information Circular 6330, by C. W. Owings, associate engineer and J. M. Harrington, senior foreman miner, in the hope that they may be of value to others whose duties require the movement of explosives by automobile.

"When used in hauling explosives the vehicle must be placarded 'High Explosives—Dangerous' and it must conform with any other regulations, laws, or ordinances of the Interstate Commerce Commission and of the states, municipalities, and communities through which it is to pass," the bureau's instructions set forth.

"Before explosives are loaded into vehicle the body of the vehicle should be thoroughly swept.

"Vehicles must always be kept in first class repair.

"Boxes of explosives must be so arranged and stayed in the body of the vehicles that they cannot shift during transportation.

"The containers of explosives must be protected from exposure to the sun's rays, rain, snow, etc. They should rest upon and be covered by a canvas or tarpaulin. Preferably they should be placed and locked in a large covered box or compartment; the inside surfaces should be wholly of wood. The box or compartment must be located as far as possible from the engine and effectively insulated from it and from all sources of electricity. The engine exhaust must be pointed downward.

"No detonators or electric detonators should be hauled with explosives, except when going to make a demonstration; to fire a blast; or in the collection of field samples, and then the detonators or electric detonators must be placed in such a receptacle and at so remote a distance from the explosives in the vehicle that the explosion of the detonators, or electric detonators, could not induce the explosion of the explosives through the intervening barricades. In order to prevent any accumulation of static electrical charges on the truck a metallic chain sufficiently long so that at least four inches of its end will drag upon the ground should be attached to the rear end of the truck, or motor vehicle.

"No metallic objects, such as tools and machinery, or heavy masses should be hauled in the same vehicle with explosives, or with detonators, or electric detonators.

"No vehicle containing explosives shall be left until the motor has been stopped and the brakes set. Safe practice requires that there should always be a guard on a vehicle containing explosives.

"During haulage of explosives avoid as much as possible congested thoroughfares, places where crowds are assembled, street car tracks, and dangerous crossings."

Information Circular 6330 also contains rules for transporting explosives, as recommended by the Institute of Makers of Explosives, and standard specifications for trucks hauling explosives, prepared by one of the large powder manufacturing companies. The report also recounts a number of recent accidents and gives recommendations as to how such accidents might be avoided.

Copies of Information Circular 6330, "Some Hazards of Transporting Explosives in Automobile Trucks," may be obtained from the United States Bureau of Mines, Department of Commerce, Washington, D. C.

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Large Highway Lettings in Louisiana

Bids were opened early in February by the Louisiana Highway Commission for the largest single highway construction letting in the history of the state. Additional bids on a letting of similar scope will be received on March 17, making a total of \$27,000,000 within the last few months. The bids received involve work that will cost between \$8,000,000 and \$9,000,000. Thirty-seven different projects covering 439 miles of construction in some 40 parishes are covered by the bids. Of this work, 285 miles will be represented by concrete paving and the rest asphaltic surfacing or amiesite paving. The bids to be received March 17 will call for construction of 190.2 miles of concrete, 127.3 miles of asphaltic surfacing, 48.4 miles of amiesite pavement, five bridges, 7.6 miles of shell and gravel and 48.6 miles of grading. A bridge over the Industrial canal in New Orleans with a roadway width of 40 ft. will be included in this letting.

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Feet—Not Inches

In an advertisement sponsored by the Continental Motors Corp. in the February issue, an unfortunate typographical error appeared which sadly underrated the efficiency and capacity of a Moretrench well-point system operating on an interesting pumping job in the Sheepshead Bay section of Brooklyn, N. Y. The advertisement was so worded as to say that the Moretrench pump was lowering the ground water level 18 in., whereas the facts are that the level was reduced 18 ft.

In justice to the Moore Trench Machine Co., Continental hastens to correct the unfortunate error, particularly in view of the fact that this Sheepshead Bay operation is an unusually striking instance of the ability of the Moretrench system to handle a pumping job where the success of the whole building operation depends absolutely on the pump.

MIXED-IN-PLACE



Completed Surface Just Prior to Application of Seal Coat

Construction in West Virginia

By H. J. SPELMAN

Chief Engineer, West Virginia State Highway Department

DURING the past season there have been built in West Virginia 164 miles of mixed-in-place top course, ranging from thin resurfacings to smooth-up rough macadam to 2-in. top courses constructed on knapped or crushed stone bases. The cost of this work was approximately \$1,000,000. Of this mileage, 115 miles were built under contract and the remainder was done by state forces.

Bases, Aggregates and Asphalt.—The bases on which this type of top was constructed included native gravel, Ohio River gravel, crushed stone, knapped stone, traffic-bound stone, bituminous macadam and brick. The widths of construction varied from 16 to 20 ft.

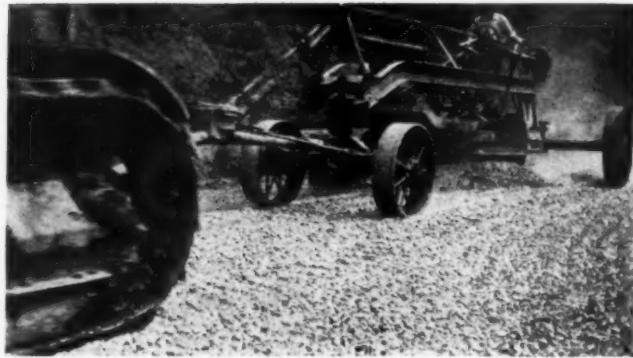
For aggregates crushed gravel, crushed stone and crushed slag have been used. The size called for is from $\frac{1}{2}$ to $1\frac{1}{2}$ in. for construction work, but for thin resurfacings of old macadam we have used material from $\frac{1}{4}$ to

$\frac{3}{4}$ in. in size. Cut-back asphalt has been used with excellent results.

Use in Widening Old Roads.—One of the most promising possibilities that we see for this retread or mixed-in-place construction is in the widening of old roads. In West Virginia we have a good many miles of 16-ft. macadam, and in fact we did not until this year definitely adopt a minimum width of 18 ft. of surfacing on state roads. These older 16-ft. roads were built with what seems today to be an excessive crown, while settlements have occurred in spots and the surfaces are not smooth-riding. This year we have let contracts for widening 5 miles of 16-ft. macadam to 20 ft., providing for the construction of either 2 ft. of crushed stone base on each side or 4 ft. on one side, building this base up to somewhat above the level of the edge of the old road, and then constructing a retread over the entire surface.



Left—Showing Unevenness of Base after Application of Prime Coat. Right—Method of Spreading Gravel for Mixed-in-Place Surface



Left—Drying Crushed Gravel by Harrowing before First Application of Asphalt. Right—Turning Over Gravel To Dry It before First Application of Asphalt

This has given us a splendid smooth-riding 20-ft. roadway. Under a similar form of construction an old 9-ft. pavement was widened to 18 ft. The results obtained with this work, particularly with widening the 16-ft. pavement, have been so satisfactory that we will undoubtedly do much more of it next season. It provides a low-cost solution of our troubles with the 16-ft. macadams near the larger population centers, and the work can be rapidly completed.

Use in Smoothing Up Old Bituminous Macadam.—Another valuable use we have found for this mixed-in-place or retread construction has been in the smoothing-up of rough bituminous macadam roads. Some of our bituminous macadam roads were built on knapped stone base, similar to the old sub-base construction, and were not originally built particularly smooth. This did not matter when average traffic speeds were from 20 to 25 m. p. h., but with the doubling of these speeds it has become important. During the past season, mixed-in-place has been used for resurfacing most of them and during the coming season we expect to resurface any others that are not

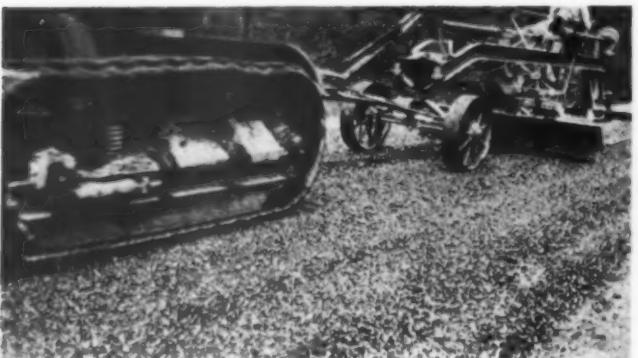
smooth-riding, so that the end of 1931 should see the last of any rough-riding roads on the state road system.

Construction Methods.—On all of our construction this year we have provided for cleaning and priming the surface of the existing road or base. The bituminous macadams of course do not take much cleaning, but the gravel and stone bases take pretty thorough sweeping. The prime varies of course. On bituminous macadam as little as $\frac{1}{6}$ gal. per sq. yd. is satisfactory, while the knapped or crushed stone bases will require from $\frac{1}{8}$ to $\frac{1}{2}$ gal. per sq. yd. Except for the cleaning and priming, the methods are the same on all of this work and I will briefly describe one contract (which is typical of construction methods), 26 miles long, on knapped sandstone base for 20 miles and Ohio River gravel for 6 miles. The mixed-in-place top on this job was placed during the past season by one contractor. This particular outfit built 40 miles during 1930 for the state.

The knapped stone base was thoroughly swept with a big circular sweeper drawn by a truck. As fast as this sweeping was completed, dirty spots were cleaned by hand



Left—First Application of Cut-Back Asphalt. Right—Mixing Gravel and Asphalt with Harrow



Left—Smoothing Retread Mixture before Dragging. Right—Dragging Retread Mixture. Note How Wheels of Drag Keep Drag in Place on Superelevated Curve



Two Views of Drag

with wire brooms and the prime coat then applied. The first application of prime at a rate of $\frac{1}{4}$ gal. per sq. yd. was made over most of the job before any of the top course proper was started. All of the material had to be hauled in over one end, and it was found that applying the prime in advance helped guard against any deterioration of the base under traffic, and did little or no injury to the primed base. A second application of prime at the rate of $\frac{1}{10}$ gal. per sq. yd. was applied just before spreading the gravel to freshen the primed base. No cover was used with the prime.

The aggregate for this job was Ohio River gravel, the specifications requiring at least 60 per cent to be crushed, and ranging in size from $\frac{1}{2}$ to $1\frac{1}{2}$ in. After priming, this material was dumped from trucks and spread with mechanical spreaders to a thickness of about $2\frac{1}{4}$ in. uniformly over the road. Traffic was permitted to travel through this until just prior to the first application of asphalt, when the crushed gravel was smoothed up with a 12-ft. blade drawn by a 10-ton tractor, and the asphalt immediately applied at a rate of $\frac{1}{2}$ gal. per sq. yd. This was then thoroughly mixed by successive trips of a disc harrow; after which it was windrowed by the 12-ft. blade to the center, turned back and smoothed down. The second application of asphalt at a rate of approximately 0.55 gal. per sq. yd. was then made. It was then again thoroughly mixed by the disc harrow and turned over several times by the blade; after which it was smoothed down over the entire surface, and then dragged continuously by a drag hauled by a 10-ton tractor until it set up. When it had set sufficiently it was rolled thoroughly with a 10-ton roller. The roller was equipped with lights and worked all night long. After the completion of the entire section, a light application of $\frac{1}{4}$ to $\frac{3}{4}$ -in. gravel chips was spread over the surface of the road, at the rate of about 20 lb. per sq. yd. The seal application of asphalt at the rate of 0.35 gal. per sq. yd. was then applied, and this treatment thoroughly dragged by the big drag and rolled.

Some tendency to pick up in a few spots under traffic occurred on this job as on this type of construction generally, and these spots were patched with gravel chips and applications of the same cut-back material.

The road was not closed to traffic at any time during any of the operations. It was found necessary though, to provide for one-way traffic with watchmen at each end, past the sections where the bituminous material was being spread and the blading was being done.

Costs.—On this particular job both bituminous material and gravel had to be hauled an average distance of 18 miles, the maximum haul being 31 miles and the minimum haul 5 miles. The unit prices for this job were as follows: asphalt per gallon, $12\frac{1}{2}$ ct.; gravel per ton, \$3.85; cleaning old surface per square yard, 1 ct. The cost per mile of 18-ft. surface, including quite a number of widened curves, was \$6,840; and the cost per square yard was 57 ct. These figures are based upon the final estimates, but do not include engineering and inspection. Because of the long haul this was higher than other similar work done during the year; but it was less than half of the estimated cost of a penetration macadam surface.

The completed road compares favorably in riding qualities with any we have ever built, and is superior in this regard to our former penetration and surface-treated macadams.

New Features in Construction.—The use of the disc harrow is a new feature tried out on this year's work. It apparently provides for a more thorough mixture of the asphalt and aggregates than the constant turning by the road-machine blade. It was not called for in the specifications for the year's work, but is now being incorporated in our specifications because of this year's experience. It reduces the amount of turning to be done with the blade and accomplishes the same purpose more thoroughly, and at no greater expense.

Another new feature adopted by the contractor on this



Left—Retread Mixture Just Prior to Rolling. Right—Rolling Retread Mixture

particular job was the placing of wheels on the drag. The type of drag heretofore used was difficult to turn, did mess up the surface badly when turned and also dragged dirt on to the pavement when being hauled into and off of the shoulders. With the wheel rig adopted, the drag can be swung up on to the wheels, turned around easily and then let down.

For good results with this type of construction, the quantities of both aggregates and bituminous materials have to be varied depending upon the smoothness of the base upon which it is placed.

It is also important to leave on the job when it is completed a quantity of chips and bituminous materials for patching at once even the smallest signs of raveling that develop; and the maintenance forces should follow the completion of the job very closely.

The pictures show clearly the various stages of the construction and the various operations.

Acknowledgement.—The foregoing is abstracted from a paper presented at the 9th annual Asphalt Paving Conference.

9,349 Miles of Federal-Aid Roads Completed in Fiscal Year 1930

The 48 States and Hawaii, with the aid of Federal funds, completed improvements on 9,349 miles of Federal-aid highways during the fiscal year 1930, according to records of the U. S. Bureau of Public Roads. At the end of the year, 9,915 miles were in process of improvement, and 3,469 miles were approved for construction. The amount of Federal funds disbursed during the year on all active road and bridge projects amounted to \$75,880,963, about \$6,200,000 less than for 1929.

In the Federal-aid system at the close of the year there were 193,049 miles of highways, 84,012 miles of which had been improved with Federal aid. The Federal-aid operations have resulted in the improvement of less than half of the system, and the States and other agencies with local funds have been simultaneously improving roads in the system so that today nearly all of it is improved to some degree.

The mileage improved during the year with Federal aid was divided into three classes: 7,317 miles, upon which no Federal funds had previously been spent, were classified as initially improved; 2,011 miles, previously improved to some extent with Federal aid, were improved further by additional joint work of the States and Federal Government; and 21 miles, built in previous years and since subjected to traffic in excess of the anticipated volume, were reconstructed and improved with more durable surfaces. These 21 miles are the first to be reconstructed under the Federal-aid plan.

Included in the initially improved and stage construction classification were 46 miles of bridges and approaches. At the close of the year, another 85 miles were either under construction or approved for construction.

The total of 9,328 miles of initially improved and stage construction projects completed in 1930 is 57 miles less than for 1929, and is lower than in any year since 1924. The decrease was due to the contraction of the program to a \$75,000,000 basis (the sum appropriated by Congress for several years) and the final absorption

of the unobligated balance of funds appropriated for the earlier years.

With the authorization of Federal funds for each of the years 1931, 1932 and 1933 increased to \$125,000,000, the bureau anticipates an increase in mileages improved. When the \$75,000,000 originally authorized for 1931 was increased by the apportionment of an additional \$50,000,000 in April, the States immediately responded by increasing the allotments to definite projects to \$102,498,084 for the fiscal year, as compared with \$70,428,896 during the fiscal year 1929.

The apportionment of the additional \$50,000,000 of Federal funds authorized for 1931 immediately increased the number of men employed on road work. In April, the number employed was more than 4,000 greater than in the same month of 1929. May and June also showed increased employment of 4,800 and 1,300 men respectively, as compared with the 1929 construction force. In August, the Federal-aid road program alone gave employment to more than 48,000 men. These figures represent the contractors' forces employed in construction of roads, and do not include the employment of workmen in the preparation and transportation of the large quantities of material required by the enlarged program.

Of the 84,012 miles in the Federal-aid system classified as improved with Federal funds at the end of 1930, 12,448 miles are graded and drained earth roads; 7,166 miles are untreated sand-clay roads; 17 miles are bituminous treated sand-clay; 28,608 miles have untreated gravel surfaces and 482 bituminous-treated gravel surfaces; 1,754 miles have waterbound macadam surfaces; 603 miles are surfaced with bituminous-treated macadam; 742 miles are improved with low-cost bituminous mixed surfaces; 4,057 miles are surfaced with bituminous macadam, 3,205 miles are paved with bituminous concrete; 23,693 miles are Portland cement concrete pavements, and 905 miles are block pavements.

Device for Giving Side-Street Traffic the Right-of-Way

A traffic light controlled by photo-electric cells has been in service for some months at the intersection of the Lincoln Highway with Trenton Avenue in Wilkensburg, Pa. The object of this light is to give vehicles on the side street a right-of-way across the main thoroughfare. The thousand cars or so an hour on the main traffic artery find the light always green, except when an occasional machine on the side street drives up to the intersection. Then the lights change, the car on the side street gets its chance and traffic on the main highway immediately resumes.

The car on the side street obtains the green light merely by standing opposite a yellow painted post at the curb. In this post is a photo cell on which is trained a beam of light from a small projector on the opposite side of the cross street. A car stopping between the two intercepts the beam, puts the photo cell in relative darkness and through a photo-electric tube operates the traffic light. Cars turning into the side street from the main highway have no effect, as the device includes a 3 to 5-second time delay. Should there be an unusual flow of traffic in the side street, or should the mechanism get out of order, the traffic light reverts to the regular alternate cycle natural to traffic lights. The device, a research development of the Westinghouse Electric & Mfg. Co., is described in the January issue of the *Electric Journal*.

EDITORIALS

Teaching the History of Scientific Theories

READING the history of the evolution of a scientific theory invariably gives a better understanding of the theory. Instead of the usual scholastic method of teaching a theory as it exists in its present state, may it not be wiser to require the student to trace its progress from its first crude form to its more elegant shape? If this is done the mind of the student travels over the various difficulties that beset all the researchers who assisted in developing the theory. One by one, the student conquers the difficulties, much as they were originally conquered. Not only is this the easiest way to master a theory, but it is, by all odds, the most interesting way.

The elegance of proof by which a quantitative theory is demonstrated usually appeals to the teacher far more than to the pupil. To the pupil great elegance of proof, particularly mathematical proof, is positively dismaying. It makes him feel that only supreme genius could have discovered such evidence of truth. Consider, for example, your feelings when you first read the geometrical demonstration that the square on the hypotenuse equals the sum of the squares on the other two sides of a right-angled triangle. What a God-gifted man was Euclid to have devised that proof! The fact of the matter probably is that some carpenter or surveyor first discovered "the three-four-five rule" empirically. Later he or some other experimenter in the paper and pencil laboratory probably found that other triangles than the one whose sides are 3, 4 and 5 units long disclose a similar relationship. Thus far all was empirical, the result of experiment. Then came some man, probably long before Euclid, who tried to establish the truth of the empirical rule about right-angled triangles by a process of reasoning that we term mathematical deduction. Probably that man failed at first; but certainty of the truth of the empirical rule must have spurred him to renewed efforts, until success finally was his reward.

We know that such has been the history of many a physical formula. There are, for example, the celebrated laws of Kepler about the orbits of planets, arrived at empirically by him, and subsequently deduced mathematically by Newton. Yet even Newton's deduction is founded upon a purely empirical law, namely his celebrated law of gravitation. Newton was never able to give any reason why gravitation should vary inversely as the square of the distance. He guessed that it might so vary. Hooke had independently guessed that relationship. Newton established the truth of his guess by showing that it is almost perfectly in accord with the amount of departure of the moon from a tangent during a second. But that did not constitute mathematical proof of the sort used in geometry. It was proof by appeal to measurements, and therefore was exactly the sort of proof that was used by the discoverer of the empirical rule as to right-angled triangles.

In the realm of physical science proof of the truth of a formula by appeal to measurements is the commonest form of proof, and is usually the original form of proof used by the first discoverer of a quantitative relationship. For reasons not wholly clear, most mathematicians abhor that type of proof. Yet their axioms are sustainable in no other manner. All talk about the

self-evidence of geometrical axioms is just "talk," if by self-evidence is meant anything else than ease of proof by appeal to count or measurement. Equals added to equals make equals. Axiomatic? Yes. Why? Because many trials can be speedily made and shown to be in accord with the axiom. There is no intuitive knowledge of this axiom, else a child would know it. A high-school boy finds it necessary to learn it; and its "self-evidence" is to him only the evidence resulting from a number of tests of its truth. Until he makes such tests, he receives the axiom on faith.

In spite of the effort to teach students to think, few really learn much about thinking. Failure to develop thinkers is commonly attributed to natural ineptitude. "You can't put brains into a cabbage-head." But who has ever proved that such an excuse is a true one? May not the real explanation be that the common methods of teaching are not of a sort that serve best to train students to think? The first external symptom that a student is thinking is an attitude of attention. The next evidence is some manifestation of interest, such as a stream of questions from the student. In most of the classes that we have attended or watched, neither of these symptoms of brain activity has been pronounced. If a stream of questions is heard, it usually comes from the teacher and not from a pupil. The typical pupil is lethargic, and the teacher's questions are designed to find out how attentive he has been.

There was a feeble effort about two generations ago to teach the science of thinking. That effort has almost died. Does not the very fact of the moribund condition of logic itself indicate that most of our teachers have given too little thought to the art of training students to think? Surely thinking is not to be completely mastered as an art merely by inculcating it as a by-product; for were that possible mathematics could be mastered without studying algebra, geometry, etc., as such, merely by picking up mathematical knowledge as a by-product of physics or the like.

Since example is better than precept, it follows that studying the methods used by researchers must be better mental training than studying merely the proof of the principles discovered by them. To this end the historical method of studying a principle or theory, or formula, is well adapted. Interest in great men and their struggles to solve problems is aroused by such historical reviews. If properly conducted, the mental processes of those men are disclosed. Incidentally these gods cease to be inimitable gods, and become very human clay, yet clay of wonderful ability to achieve desired results—the same sort of clay that every one of us is made of, a bit finer in one man than in another, but fine in all if properly treated.

Some Questionable Schemes for Creating Jobs for the Jobless

"MANCHESTER, N. H., has let a contract for public works which specifies that all the labor shall be by hand." Of course the idea is to "make more work" by excluding machinery. Is this a wise procedure? Would it not be better to use machinery and perform a larger amount of construction? The Manchesterian reply

would probably be like this: "No, for only skilled men can handle machines, and our object is to provide jobs for the jobless regardless of skill."

No small amount of public work is now being done with the sole object of providing jobs for the jobless, but where this is the case every effort should be made to employ unskilled men only on the kinds of work that such men are competent to perform. To put a man to mixing concrete by hand, merely to make work, savors of the prison stone-pile where "broken stone" is made with a hammer.

It must be conceded that in this machine age a public official is confronted with no easy problem when asked to make jobs for the jobless who are incompetent to handle machinery. We raise the question whether legislators should ever require public executives to "make work" regardless of the economic efficiency of its performance, as in the case of Manchester. In such instances it amounts to a disguised form of "dole," and if "dole" must be given is it not better to give it outright, undisguised?

It seems to us that it is unwise to pay an unskilled laborer \$4 for an amount of work that could be done for \$1 by a machine under a skilled operator, for it fosters the delusion that the laborer is not the object of charity. In America, at any rate, to be an object of charity is not a pleasing thought for the recipient of the charity. Consequently he usually seeks to escape from what he regards as a stigma. This desire is entirely to his credit, and it usually serves to drive him to secure a job in which he renders a full "quid pro quo." Furthermore, where the recipient of charity is entirely callous, he can usually be forced ultimately to abandon dependence upon charity if he receives very much less than he could earn by working. While it seems hard hearted thus to prod charity recipients into exerting themselves to secure jobs that are not given to them merely because of sympathy, in the long run such prodding is the kindest of acts. One has but to consider the doleful consequences of the "dole" in Great Britain to realize that too liberal charity is disastrous alike to the donor and to the recipient.

Increased expenditures for public works in hard times are not charity even in a disguised form, provided that the work is done in the most economic manner and serves an economic purpose after it is finished. It furnishes a general stimulus to industry when a stimulus is most needed, and it has none of the ill effects inherent in so many schemes to alleviate unemployment.

H. P. Gillette

Highway Research

ACCORDING to Webster, research is a "searching for something especially with care or diligence. Careful or critical examination in seeking facts or principles; diligent investigation." It follows, therefore, that an investigator who leaves the field clearer when he finishes his investigation than when he started his work should be classed as a researcher.

There are two principal types of highway research: (1) Fact-finding surveys in which information on good and bad practice is collected and summarized. From this information, conclusions are drawn which are of benefit to an industry as a whole, to specific branches of the industry or to the public at large. (2) Experimental research in which the researcher performs or supervises experiments, tests or measurements, to the end that un-

certainties may be overcome and facts established.

There is a need for both types of research in the highway industry. Research of Type 1, the fact-finding survey, is needed to correlate best present practice, to eliminate bad methods, to encourage good methods and, in general, to evaluate facts which are sensed but not yet proved because the phenomenal growth of the highway industry has outstepped its research activities. Research of Type 2 is necessary to develop new ideas, new materials, new methods, new equipment; but a definite knowledge of the facts established in Type 1 is necessary for best results in Type 2. In general, the best researchers are those who have a background of experience, as well as education, and who can choose between the good and the bad, the important and the unimportant. This is particularly true for Type 1, where judgment based on experience can alone bring measurable results.

In Type 2, the experimental type, the same characteristics of keen observation are necessary, but the background of experience is not as essential—only good supervision and correct interpretation of results by an experienced person are required, while the mechanical processes may well be performed by a less experienced person.

It follows, therefore, that undergraduates of universities should not be left to their own resources in research which vitally concerns a great industry, but that they should receive close and constant supervision. In general, and in particular, a desirable type of researcher is one who can see things as they are and can describe them as he sees them.

Mechanical Equipment and Road Building

EVEN if it were cheaper to build roads by hand methods, which it is not, instead of by mechanical equipment, public officials would and could ill afford to permit it as a general policy. Contractors do not use hand labor instead of mechanical equipment, and it is commonly agreed that construction by contract is the most economical method.

Quality of product and quantity of production in road building can be obtained only by extensive use of mechanical equipment. Representing not over 10 per cent of the total cost of a road, it has been the greatest factor in giving the public roads at lower and lower cost and of better and better quality.

Several types of equipment which were innovations less than ten years ago are now commonplace. So rapid has been the progress of the art that some equipment has become obsolete in less than five years. Ten years ago highway engineers looked skeptically at each new piece of road-building machinery, and the manufacturer was fortunate indeed who could persuade the state highway engineer or his contractor to try out these innovations. Today conditions are reversed and we find highway engineers and contractors urging manufacturers to provide equipment which will cut construction cost, speed production and improve the quality of roads.

Improvements in present types of equipment are needed, entirely new types are in demand, but a clearing-house on equipment information must be provided in which needs may be expressed, adaptability investigated and impartial information disseminated.

P. R. Morris

County and Township Roads

A Section Devoted to the Interests of Those Responsible for Secondary Road Improvement



Left—Section of North Star Oil-Mix Gravel Road. Right—Just East of the Primary Road on the North Star Mile in Gratiot County

Low-Cost Bituminous Surfaces

By GEORGE H. CLOW

Superintendent of Roads, Gratiot County, Mich.

IN THE spring of 1928 the road commission of Gratiot County, Mich., decided to use some kind of bituminous tread on some of the gravel roads of the county. After some discussion they decided to try 3 miles of asphalt, mixed in place, and 1 mile of cold-mix asphalt, (asphalt and crushed field stone mixed in a mixer and placed on the road in forms 3 in. thick). This was done with good results for the retread and with extra good results with the cold-mix.

In 1929 we put on 16 miles of three different kinds of material, asphalt, oil and tarvia—one job of 5 miles of 9-ft. tread, the rest 18 ft. or from grass to grass. In 1930 we put on 21 miles all, 18 ft. or more wide, 20½ miles of oil and ½ mile of cold-mix. In the three years the road commission has placed about 41 miles of bituminous tread on their roads.

The mixed-in-place treads are giving good service with a small amount of maintenance. The cold-mix, which we placed in the small towns, is giving extra good service, one strip of ½ mile having given two years' service without any maintenance.

In 1929 the writer read a paper describing the oil-sand-gravel method in California. He talked with a

representative of an oil company who wanted us to put on and try out a mile, which we did with excellent results. We placed this on the road from U. S. Route 27 to North Star, which is now known as the North Star mile. This road was built at a cost of \$2,300.

Material and Labor Requirements.—Some miles we placed cost more, and some less. To build a mile of oil-sand-gravel processing 18 ft. wide, the following material and labor are used:

- 880 yd. of sand and gravel.
- 15,840 gal. of oil.
- 2 men on the distributor, working 1½ days.
- 3 men on tractor, working 4 days.
- 2 men on grader, working 4 days.
- 2 traffic men, working 4 days.
- 1 fireman, working 2 nights and one day.
- 1 man to haul water.

Preparation and Processing.—First we look the mile over and estimate how much loose sand and gravel there are on the road and then add enough sand and gravel that will pass a ¾-in. round opening 100 per cent, graded from ¾ in. down to 8 to 20 per cent passing a 200-mesh screen.

Spread the sand and gravel over the road the required



A Gratiot County Oil-Gravel Road Just South of Perrinton. The Marks Which Show Were Made by the Lugs of Tractors Used in Hauling Big Wagon-Loads of Beets to Sugar Factories. These Were Ironed Out by Traffic Without Serious Consequences

width. Then put on the oil with a pressure distributor at the rate of $\frac{1}{2}$ gal. per sq. yd. Immediately start working the oiled mixture with the disc. After the first application of oil is made, another one is put on using $\frac{1}{2}$ gal. per sq. yd. In the meantime keep the disc moving on the mixture. When the second application is completed a third application of $\frac{1}{2}$ gal. per sq. yd., is put on, making a total of $1\frac{1}{2}$ gal. per sq. yd. Keep the disc moving in the mixture as long as it is doing a good job of mixing. We used two discs all during this procedure. These discs can be kept operating longer during hot than during cold weather.

After using the discs all you can, take the graders and windrow the mixture on one side of the road. Move it back and forth across the road about 16 times or until the stain tests tell you the mix is right. Then spread it out and put on the maintainer until you have a smooth-riding surface. While mixing, leave the mix in windrow on one side of the road over night and the traffic can use the road without any danger.

Low Repair Costs on The North Star Road.—The so-called North Star mile, which was the pioneer oil-sand-gravel processing in Michigan, was opened to traffic Aug. 2, 1929. This mile created much interest and received considerable traffic, which compacted it in a few days. The maintainer was run over the mile every day for a week on account of horse-drawn wagons loaded with logs traveling this road. A depression came in the road in February, 1930, and in late summer two small holes appeared. We wanted to show this road to the supervisors at their October session before any cost for repair and accordingly the holes and depression were

not repaired until November, when they were fixed at a cost of \$7.

In October, 1929, we placed $3\frac{1}{2}$ miles of oil-sand-gravel processing north of St. Louis. Two and one-half miles came out fine but the last mile processed was not so good. The weather became cold and the mix became heavy, making it impossible to mix it so well. To make the mix right on this mile we were scraping some sand and gravel from the berm along the side of the road to make the necessary amount of sand and gravel in the mix. Incidentally this is a good way to remove the berm.

The road was completed and opened to traffic. During the cold weather it was all right and carried the traffic that consisted of several milk trucks with chains and other traffic, most of which had to have chains because there was no snow removal on roads coming on to these $3\frac{1}{2}$ miles. This road, however, was kept free from snow and ice in order that we might see what chains would do to it.

Chains did the road no harm, but when the weather became hot the mix became soft. The oil came to the top. It looked bad and pushed some. We covered the road with sand, some places two or three times, which blotted the oil. The maintainer was put over all of the $3\frac{1}{2}$ miles and then we covered the one mile with pea gravel, using about 100 yd. This brought the road out in fine shape, and there has been no maintenance on this road since.

We have in Gratiot County 24 miles of sand-gravel-oil mix 3 in. thick and all of it is giving excellent results, with the possible exception of one mile. This method,



An Oil-Gravel Road in Gratiot County One-half Mile South of Pompeii. Heavy Steel-Wheel Traffic Shortly after Construction Caused the Formation of Some Ruts, Which Were Almost Entirely Eliminated by One Trip of the Maintainer

like any other, has its limit as to use. If you have traffic enough of the motor-vehicle type to compact it in a few days, it will stand any kind of traffic that complies with the laws of the state of Michigan. But if it does not have enough traffic, then horse-drawn wagons loaded with from 3 to 5 tons of sugar beets will give some trouble on account of ruts.

Maintenance of Oil-Sand-Gravel Roads.—Some of the roads we placed last fall received some very heavy beet traffic, both trucks and horses, and some spade-lug tractors, which cut them up some and dug some holes. We put the maintainer with new blades on over these roads to smooth them. It did a fine job. The maintainer will cut off the high spots and fill the low spots; the traffic compacts it and now it is good. If a hole comes in the road we add a little oil, then scrape a little material from the side of the road and fill the hole.

Some of the things we have learned about the oil method are the following:

1. If we have some kind of cement-like binder like stone dust or some of the yellow material that is in some pits that makes gravel bind, it will help compaction.
2. Do the work in warm weather.
3. Oil treatment improves service, eliminates dust and increases smoothness; therefore it is popular with the public.

* * *

Counties Improved 45,481 Miles of Highways in 1929

A total of 45,481 miles of local and county roads, exclusive of state highways, was improved in 1929 by the counties of the 48 states, it is indicated by reports obtained from authorities of selected counties by the Bureau of Public Roads, U. S. Department of Agriculture. These reports indicate a total of 2,710,097 miles of highway in the county road systems.

The reports indicate that all counties spent a total of \$807,714,604 in the year for county and local road and bridge construction, including payments on bonds and transfers to state highway departments. It is estimated that available funds amounted to \$953,529,592. An unexpended balance of \$145,814,988 was on hand at the end of the year.

Of the total mileage improved in the year, the reports indicate 29,804 miles, or 66 per cent, was surfaced, and 15,677 miles, or 34 per cent, was graded and drained earth roads. The surfaced mileage includes 2,905 miles of sand-clay and topsoil roads, 19,753 miles of gravel, 3,666 miles of waterbound macadam, 2,037 miles of bituminous macadam, 54 miles of sheet asphalt, 176 miles of bituminous concrete, 1,191 miles of portland cement concrete and 22 miles of brick and other block pavements.

The estimated total mileage in the county road systems includes 454,111 miles of surfaced highways, including 416,770 miles of low-type and 37,341 miles of high-type surfacings. The low-type surfacings include 75,547 miles of sand-clay and topsoil, 292,463 miles of gravel and 48,760 miles of waterbound macadam. The high-type surfacings include 16,692 miles of bituminous macadam, 1,539 miles of sheet asphalt, 4,057 miles of bituminous concrete, 13,254 miles of portland cement concrete and 1,799 miles of brick and other block pavements.

The reports from the selected counties indicate that all the counties of the states spent \$256,581,811 for

construction, \$260,477,801 for maintenance and \$49,455,959 for miscellaneous items; that they paid out \$78,277,070 for interest on outstanding bonds and notes and \$106,032,780 in retirement of the principal on the bonds and notes, and that they transferred \$56,889,183 to the states for work on state roads. The total disbursement is estimated to have been \$807,714,604.

The reports indicate that all counties had an estimated total of \$953,529,592 in available funds, consisting of an unexpended balance of \$163,401,207 carried over from the previous year, and a total income of \$790,128,385. To the total income, the motor-vehicle license fees and gasoline tax receipts allotted to the counties, \$51,886,324 and \$70,492,878 respectively, contributed 15 per cent; receipts from local bond sales, amounting to \$110,635,146, supplied 14 per cent, and the total road tax of \$414,152,567 contributed 52 per cent. Appropriations from county general funds for the use in road work amounted to \$75,018,526; transfer of funds from state to counties for local road work amounted to \$31,714,578.

* * *

And We Rush Mail by Air

Question: I have a bad piece of road on my route that is impenetrable during the winter months, on account of the high weeds and brush and other obstacles to hold up the snow and ice. The road supervisor is a patron on my route. I have called it to his attention several times but he answers me, if I cannot get through with the mail he could go and get his mail from the post office. There will be thirteen patrons that will not get their mail if the carrier cannot get through this bad stretch of road. [What] must the postmaster give a patron in a case like this, and whom can I refer this case to?

Answer: The facts should be submitted to the first assistant postmaster-general for attention.—*National Rural Letter Carrier*.

Our Answer: Refuse delivery of mail and agitate among twelve other patrons for low-cost surface treatment and proper maintenance.

* * *

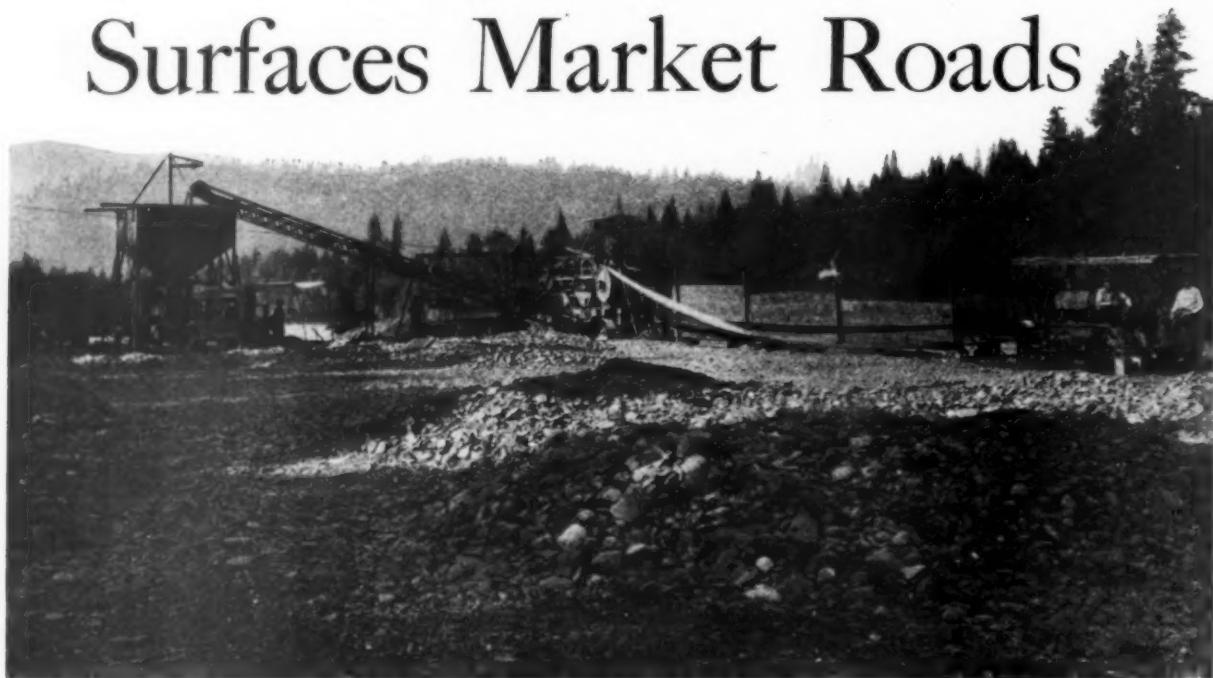
Road Regiment's Reunion

Builders of highways and bridges who served during the world war in the 23d Engineers will hold their first national reunion March 19 and 20 in the Hotel Astor, Times Square, New York, N. Y.

James J. Walker, mayor of New York City, is to give a reception to the regiment in the aldermanic chambers at city hall, with a guard of honor from the army, the navy and the national guard. An inspection of New York harbor, luncheon on board the *S. S. George Washington*, on which the 23d Engineers went to France, a theater party, military exhibit, company reunions and a banquet are included in the program.

This regiment of 4,880 men, next to the largest in the world war, was recruited by volunteer enlistment of technical and specially trained men secured through extensive advertising in the publications of the construction industries. It is believed to have included a larger number of trained engineers than any other unit. Interest in the coming reunion has been stimulated by the *Highwayman*, the regimental newspaper.

Oregon County Surfaces Market Roads



Crushing, Screening and Loading Plant Owned by Josephine County, Ore.

By J. G. BROMLEY

County Engineer, Josephine County, Ore.

GETTING the farmer out of the mud in Josephine County, Ore., is being accomplished through the employment of a portable rock and gravel crushing, screening and loading plant, also a hoist and dragline unit. Ten miles of market road, known as the Applegate River-River Banks-Shan Creek-Pickett Creek Market Road, will be surfaced with 1½ in. crushed gravel. Two thousand cubic yards of 1-in. material will be placed in stockpiles and 600 cu. yd. of 3-in. material will be placed near a bridge site on this road to be used for concrete construction. It is expected that approximately 10,000 cu. yd. of material will be crushed from the first set-up.

The plant was unloaded from cars the latter part of March, 1930, and taken to the Busch gravel bar on Rouge River, 1 mile upstream from the Pacific Highway Bridge over Rouge River at Grants Pass, Ore. Crushing operations started on April 1, 1930. Josephine County is fortunately situated as regards excellent road materials. The abrasion test on Rouge River gravel is 2.30.

This gravel averages relatively the same uniformity as regards screening tests and abrasion. Following is a typical analysis: 5 per cent sand (material passing the ¼-in. screen), 20 per cent passing the 1-in. screen and retained on the ¼-in., 40 per cent passing the 2-in. and retained on the 1-in., 25 per cent passing the 3-in. and retained on the 2-in., the remainder 10 per cent oversize.

The county placed two F.W.D. 2-ton trucks and two Ford 1½-ton trucks on the job hauling crushed gravel to the county roads. The average haul from the plant was 4 miles. Fourteen different roads were completely surfaced with 1¼-in. material.

During the four months of operations, April, May, June and July, 1930, a total of 10,000 cu. yd. was crushed and delivered and spread on 14 different roads. The major portion of the gravel taken from this set-up was handled by a ¾-yd. self-filling bucket, drawn by 5/8-in. cables attached to the south bank of the river 400 ft. away. An average of 110 cu. yd. was delivered daily.



Continuous Operation of County-Owned Plant Resulted in Low Surfacing Costs



General View of Pit and Plant Arrangement

This we consider a remarkable record, taking into account delays in moving cable and other minor delays incidental to crushing-plant operations.

On July 24, 1930, the plant was moved to the Upper Ferry gravel pit on Rouge River, 14 miles west of Grants Pass. From Aug. 1, when the plant started operating here, until Sept. 20, when the job from this set-up was completed, a total of 5,000 cu. yd. of material was crushed and spread on the road. An average of 120 cu. yd. a day has been recorded. The set-up is ideal. Considerable credit is due the plant men and the truck drivers. Their co-operative spirit has made it possible to weld together an organization that functions perfectly. This resulted partly from the fact that a local plant in the city was keeping a watchful eye on us, as were the taxpayers also.

Costs.—The crew consists of a foreman hoist operator, crusher runner and laborer. At the first set-up, Busch bar, the material was placed in the bunkers for an average of 70 ct. a cu. yd. and delivered in place on the road for 18 ct. a yd.-mile. At the second set-up, Upper Ferry bar, the cost averages 52 ct. a cu. yd. and the haul 17 ct. a yd.-mile. Cost data are based on \$20 a day for the crusher and \$10 a day for the power unit. This is a very mountainous section of the state, but the plant is easily moved over any type of road and placed on rugged bars. In 5½ months this plant has been in constant operation and produced 15,000 cu. yd. of crushed gravel.

The Josephine County Commission, L. R. Conklin and J. S. Stanbrough, members, and C. G. Gillette, county judge, purchased this Pioneer outfit complete for the express purpose of improving our market road systems.

Michigan Road Conference Studies Low-Cost Roads

Low-cost farm-to-market roads were given especial attention at the 7th annual conference on highway engineering at the University of Michigan, Feb. 18 to 20, at which time the College of Engineering conducted a meeting attended by more than 600 road commissioners and engineers from the state highway department and the various counties of the state.

The entire Friday morning program was given over to the discussion of low-cost bituminous highways and a series of talks and papers given by men who have had experience with various types of mixed-in-place and plant-mixed roads of a bituminous nature. These men were E. H. Edyvean, resident maintenance engineer, Michigan State Highway Department, Cadillac; C. F. Winkler, engineer, Houghton County; M. Bidleman, superintendent, Leelanau County; George Clow, superintendent, Gratiot County; E. K. MacAllister, engineer, Jackson County; Leon Luke, engineer, McComb County.

The meeting was presided over by K. I. Sawyer, engineer-manager of Marquette County. His was the first county to create a permanent construction fund to be loaned without interest to townships and repaid in annual installments—a plan that has been presented by ROADS AND STREETS in various issues and has received almost universal commendation and is being considered in various sections as a part of a permanent road policy.

Because of the wide attention and publicity given to the first mile of oil-mixed gravel road built by Gratiot County at North Star by George Clow in 1929, his paper presented at the conference, concerning this road and the roads that they have later constructed, should be of special interest to our readers. Mr. Clow's paper, accordingly, appears elsewhere in this section.

A considerable number of other counties have since built sections of this type of road and the programs for 1931 in Michigan indicate that probably 300 to 500 miles of this particular type of black-top roadway will be built in the various counties. Gratiot County built more than 20 miles of this road last year, all of it 18 ft. wide and all at a cost that will justify its construction from a maintenance standpoint over a period of three to five years. In other words, they figure that they can have this black-top road and use it without expending any more money over a period of five years than they would otherwise spend to maintain a reasonably good gravel road in first-class condition.

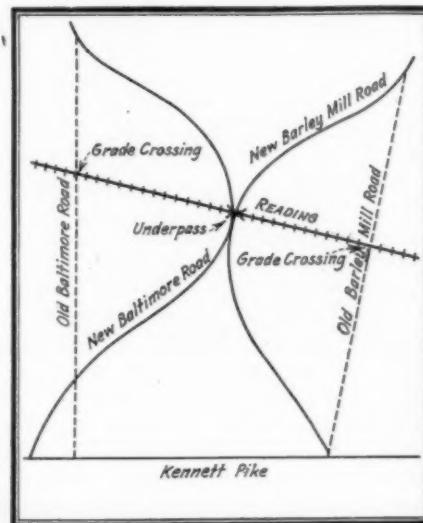
MUNICIPAL JOURNALS.—Twenty-three cities in the United States, ranging in size from Sacramento, Calif., with a population of 75,000, to New York City, publish some sort of municipal journal.

BEFORE Two Grade

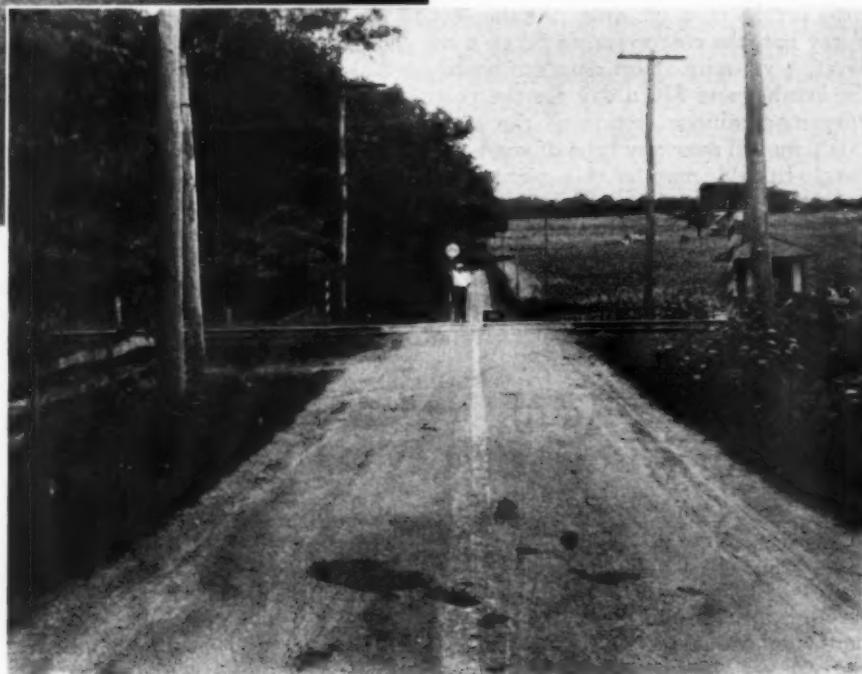
AN outstanding example of road relocation in the interest of safety and economy is illustrated by the accompanying views of a project in New Castle County, Del. As indicated in the sketch, two dangerous crossings were eliminated with the construction of a single underpass, the roads having been brought together just north of the crossing and divided again south of the railroad. Both of the former crossings were exceedingly dangerous, as the view of the railroad was obstructed by high banks and trees. A steep grade on the Barley Mill Road was an additional source of danger. The location of the underpass in the middle of a wood, giving an attractive setting, is also an advantage from the standpoint of the motorist. This improvement was begun while Charles E. Grubb, engineer-executive, County Officials' division, American Road Builders' Association, was county engineer, and was completed by his successor, A. P. Shaw. The fieldwork was in charge of E. W. Phillips. The cost of the underpass was divided between the Reading Co., the Delaware Land Development Co. and the levy court of New Castle County. The contractor for the work was the Suburban Construction Co., Ardmore, Pa.



Above—The Intersection of Baltimore Road with the Reading before Relocation Was Accomplished Gave a Dangerous Crossing. Trees and Shrubbery Obstructed the View of Drivers



Two Grade Crossings Were Eliminated by Relocation and the Construction of a Single Underpass



Right—Barley Mill Road Crossing before Relocation and Construction of the Underpass. The Steep Grade Added to Drivers' Difficulties

Crossings Were Eliminated...



Site of Underpass,
Midway between Two
Grade Crossings, be-
fore Construction

...and AFTER



Completed Underpass, Looking South

How a Texas County Purifies Its Contractors

By RUEL McDANIEL

San Antonio, Tex.

HARRIS County has found a practical way to eliminate irresponsible contractors, to a large degree, before bids for specific contracts are opened. The county accomplishes this, and several other things that make for improvement in contract-letting, through an "experience questionnaire" which it adopted a short time ago.

"We require all contractors proposing to bid on county work to file with Harris County a financial statement and experience report at least 48 hours before the time set for opening bids," explains Charles R. Haile, county engineer.

A common problem confronted by many Texas counties is one of ascertaining the responsibility of contractors proposing to take county contracts. It is a regular complaint among commissioners' courts that they let a contract to the lowest bidder, only to find before the job was under way that the winning contractor was irresponsible and financially unable to carry out his agreement.

That not only means a serious loss of time but it is a setback financially as well, for the reason that bids must be asked for again and all the routine of securing favorable contracts carried out as before.

Lose If They Win.—It also is pointed out by some members of Texas commissioners' courts that the irresponsible contractor is even a worse "buy" for the county when he completes a job than when he fails to start after winning the award. If he is irresponsible or inexperienced in that class of work, he may turn out a job that looks fair enough and may even have it accepted by the county engineer and the court, only to bring loss to the county eventually through faulty workmanship showing up later.

Harris County's plan of sorting out undesirables prior to letting the contract is a long step in the right direction in handling county road work and other county construction and equipment contracts. Call it "pre-qualification" or what you will, the plan, as Harris County manages it, means a saving of thousands of dollars a year through elimination of plain rascals in the contracting business and those who are too inexperienced to guarantee a proper job.

Any contractor who desires to enter a bid on a Harris County contract must fill out one of the experience questionnaires prior to entering his bid. These are supplied contractors, along with specifications of the job under consideration. The questionnaire forms a regular part of the bid placed by the contractor.

Predetermined Qualifications.—Along with the questionnaire, the contractor likewise is required to supply a financial statement covering his responsibility. The county has no printed form for this, however. "This financial statement and the experience questionnaire permit the county commissioners' court to predetermine the

This account of the methods adopted by Harris County to prevent unscrupulous and irresponsible contractors from securing a share of the county business first appeared in *Highway Progress*, official organ of the County Judges' and Commissioners' Association of Texas. The experience and financial status of each bidding contractor are made known through a pre-award report

responsibility of contractors seeking work from the county," explains Mr. Haile.

"In this way, delays in awarding contracts can be avoided. Formerly, any and everybody was permitted to bid on any contract open; and quite often outside firms unknown to any member of the court were found to be low bidders. Before awards could be made investigations were necessary, and all contractors' deposits were held up until these investigations could be made. This worked an unfair hardship against other contractors who had made their financial stability known to us.

"Unquestionably, experience is as important to the proper construction of a job as financial stability. We lay equally as much stress upon experience in the line of work we are about to let as we do on financial responsibility. Unless a man knows how to do the job, all his money will not produce a good job for the county."

"Irresponsible bidders cost the public much more than the usual slight difference that makes their bids low. Sometimes the lowest bid turns out to be the highest—for the county—unless the bidder is checked beforehand to determine his financial and experience qualifications."

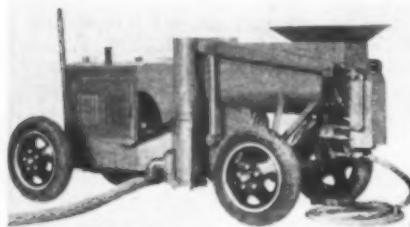
Not A Training School.—The question is raised now and then when this sort of contract-letting is discussed, as to the fairness of the plan as it affects small and beginning contractors. Proponents of more business and less personality in contract awards point out that it is not the business of the county to train inexperienced men to be contractors or to set them up in business. It is not done in other fields, they point out, so why should the county do it?

The plan does not mitigate against a small contractor, if he is honest and capable of performing the job he wants. If he is not both of these he should not expect the contract; and the county certainly cannot afford to award it to him. It actually favors the conscientious contractor, large or small, because it gives him protection against the unscrupulous competitor who trades upon the integrity of others and the irresponsibility of himself. It enables the responsible contractor to carry on his business on a high scale, without having to get down in the muck with an unscrupulous competitor in order to get a share

New Equipment and Materials

Device for Raising Sunken Pavement

A new device for raising sunken pavements has been announced by the National Equipment Corp., of Milwaukee, Wis., manufacturers of construction equipment. The N. E. C. Mud-Jack is a combination mixer and pump which corrects the pavement level by forcing the mixed mud



The N. E. C. Mud-Jack

through holes cut in the slab. The method of operation is as follows:

Topsoil and water are mixed with just enough cement to take up the shrinkage, usually about 1 bag of cement to a yard of dry material. This mixture is pumped through holes drilled in the slab, the pressure from the pump being sufficient to force the mud under the slab, causing it to rise. Normally about three holes are drilled for each 8 ft. of 18-ft. road slab.

It is stated that pavements in which dips of from 1 to 18 in. in depth occur can be returned to their original grade with ease. The pressure required to raise the slabs is low.



New Hydraulic Roll-Over Scraper

A recent addition to the line of equipment of La Plant-Choate Mfg. Co., Cedar Rapids, Ia., for use with Caterpillar tractors, is a hydraulic roll-over scraper. The



Scraper With a Full Load

following advantages are claimed for it by the manufacturer: Hydraulic control gives the operator the ability to control and vary the cutting depth instantly by merely shifting a lever from the seat. This variable

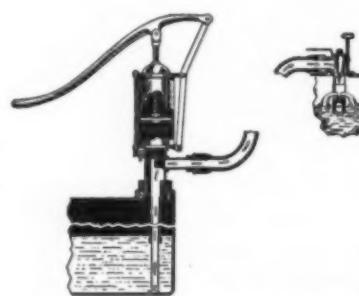


adjustment and the use of a narrower but deeper bowl, make loading easier, and permit hauling of larger capacities with the same power unit. These features also eliminate delays caused by the tractor stalling because of variation in soils while loading. They also make it possible to rotate the bowl backwards after loading on its carrying runners to carry the load rather than to drag it. They also permit spreading in instantly variable depths. The load may be dumped in one pile or spread in any desired layers. This scraper may also be backed up if desired.



Pump Makes Refueling Easy

A pump for refueling power shovels, trucks, tractors and other gasoline-operated equipment on the job has been placed on the market by the Air Way Pump Co., 625 W. Jackson Blvd., Chicago, Ill. The pump



Sectional View of Pump and Combination Indicator and Valve

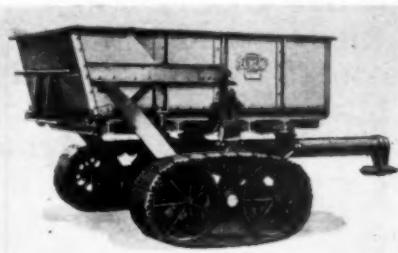
weighs 18 lb., is 36 in. high and has a cylinder 4 in. in diameter and 8 in. long, made from special drawn steel tubing. The pumping is direct, single force by pressure. By means of the pump handle air is forced into the container, increasing pressure over the liquid and causing it to flow directly through the pump chamber and out. Two types of indicators can be used, one with shut-off valve and the other without. Both types register when the tank is full, eliminating guess work as to when to stop pumping. They are made with 1-in. standard pipe fittings, and provided with a spring catch to prevent the hose pulling from the tank opening. All principal parts are made of brass.

In addition to pumping gasoline the pump also handles kerosene, lubricating and crude oils.

New 8-Yd. Track-Wheel Wagon

A new 8-yd track-wheel gravity-rear-end dump wagon particularly constructed for working under a shovel and for hauling rock, dirt, clay, sand or shale has been brought out by the road machinery division of The Euclid Crane & Hoist Co., Cleveland, Ohio.

The body is constructed of steel of



Euclid 8-yd. Gravity-Rear-End Dump Wagon

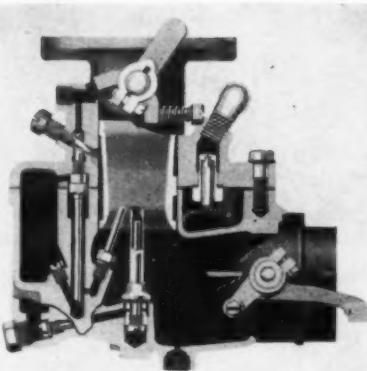
special analysis to resist the abrasive action of sand, gravel and stone. A carbon-steel reinforcing plate on the bottom of the body affords protection against heavy rocks. There are alloy-steel castings at the corners of the rear body opening to eliminate the possibility of rocks or other material warping the sides out of shape.

The wagon is under complete control of the tractor driver from his seat on the tractor. The wagon is dumped by means of a trip cord from the driver's seat to a lever on the wagon. The wagon unloads itself by gravity and when empty falls back automatically into the loading position. The design features a rear gate allowing full 8-yd-capacity loads and is arranged to raise upward at a steep angle, freeing the material at the start of the dumping and permitting ample space for discharging all loads. When hauling extremely large rocks this gate can easily be removed, leaving the rear end open for easy discharge. In cases where the driver does not get close enough to the fill, he can use the wagon as a bulldozer to push the material over the fill. This new gravity-rear-end dump is mounted on the improved Euclid 15-ton track-wheel assembly.



New Heavy-Duty Carburetor

The Zenith-Detroit Corp., Detroit, Mich., has gone into production on a new carburetor designed particularly for heavy-duty applications, such as trucks, tractors, industrial engines, etc. The series incorporates the Zenith compound system of carburetion. This consists of a main jet directly connecting fuel in the bowl with the air stream through the discharging tube, and a compensating jet which flows into an open well connected with the air stream through the supplemental jet. The main jet flow varies with suction and delivers an increasing amount of fuel as the suction increases. The open well kills the



Sectional View of Universal Type Carburetor

suction on the compensating jet so it flows the same under all conditions of suction. In combination the rich and lean jets give an average mixture of correct proportions. This series, however, has several new features: the economizer and piston assembly, the spring-loaded strangling device, the fully balanced feature and the float mechanism which will operate at great angles.

Under part throttle the suction above the throttle is higher than when the throttle is open; this holds the economizer and accelerating piston assembly and thus shuts off fuel from the power and accelerating jet. When the throttle is opened the suction falls, and so does the piston; the piston falls on the economizer valve, pushing it open and forcing out fuel through the power jet to constitute the accelerating charge. If the throttle remains open the piston continues to hold the economizer valve open, allowing fuel to flow through the power and accelerating jet. If the throttle is closed, the increasing suction above the piston draws it up, and the economizer valve closes decreasing the fuel fed to the engine.

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1931 Link-Belt Grizzly Crawler Loader

The Link-Belt Co., Philadelphia, Pa., has announced the 1931 model Link-Belt grizzly crawler loader. The 1931 grizzly has the improved helical ribbon-type feed-



The 1931 Link-Belt Grizzly Crawler Loader

er, announced in 1930, with its cast-steel spiral which digs, lifts and conveys the material to the buckets, cutting a swath 7 ft. 7 in. wide in the material handled.

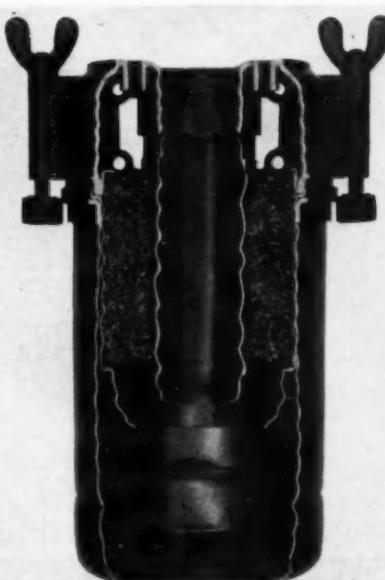
The power plant of the grizzly is a simple, compact and efficient power unit, consisting of a 30-hp. Buda gasoline engine, equipped with a governor to regulate the speed automatically; or a 20-hp. electric motor of standard specifications.

The elevator has a rated capacity of 1 1/4 cu. yds. per minute, with uniform feed, based on sand, stone and gravel, 1 1/2 in. and smaller, run-of-mine bituminous coal or coke, etc. A three-speed transmission gives the crawlers a speed of 30 ft. per minute, or 66 ft. per minute, in the digging direction, and 27 ft. per minute in reverse. Driving machinery is housed in a dust-tight casing, partly filled with oil, which assures perfect lubrication of all parts.

—♦—

New Air Cleaner for Trucks and Tractors

A new and improved air cleaner for trucks, heavy duty engines, and buses, has just been introduced by AC Spark Plug Co., Flint, Mich. The new cleaner is stated to have a cleaning efficiency of prac-



New Air Cleaner

tically 100 per cent. It will hold several pounds of dust before "plugging" warns the operator that it is necessary to clean the assembly and re-oil.

The first stage of cleaning is by the use of a stack or chimney on the top of the cleaner which supplies the air from high up under the hood, or in the case of a tractor several feet above the engine, where the air is relatively pure.

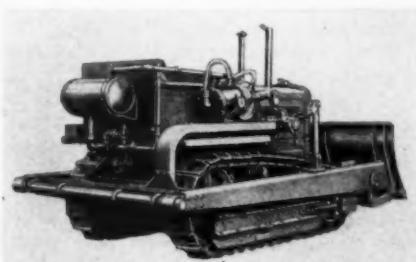
The second stage of cleaning is the impingement of dust into oil supply in bottom of cleaner as the air makes a sudden reversal upward. Laboratory tests show that nearly all of the dust entering cleaner is collected in the oil. Oil supply is retained within cleaner and cannot possibly be blown out into carburetor at any air flow.

The final stage is the passage of the air, enroute to the carburetor, through oil wetted copper mesh to which particles will adhere. This catches any dust which succeeds in getting by the second stage.

New Bates Hydraulic Bulldozer

One of the latest additions to the road machinery lines of the Foote Bros. Gear & Machine Co., 111 N. Canal St., Chicago, Ill., is the Bates hydraulic bulldozer, built especially for use in combination with Bates crawler-type road tractors.

In addition to having unusual simplified design and exceptional sturdiness, all of the operating mechanism is placed below the level of the seat, giving clear vision to the operator.



Bates Hydraulic Bulldozer

The oil pump is easily started or stopped by throwing a small clutch lever below the driver's seat. When in operation, the control of the oil pressure in the hydraulic ram is stated to raise or lower the blade of the bulldozer in 2 or 4 seconds' time, depending on the blade clearance at the time.

A three-way valve controls the oil supply. One position of the valve handle forces the oil in at one end of the cylinder and lowers the blade. In another position it forces the oil in at the opposite end of the cylinder and raises the blade. The neutral position by-passes the oil back to the tank and holds the blade at any height desired.

The Bates bulldozer is built with a heavy frame with exceptional ground clearance, and so attached that it does not interfere with the normal operation of the tractor. This frame is bolted on to the crawler frame at the back of the tractor and the lifting mechanism is attached to the tractor frame just behind the engine. The bulldozer frame does not interfere with the tractor drawbar. It is left free for hauling other equipment when required.

The major portion of the weight of the bulldozer is carried in the blade with the pivot point at the rear of the frame. The action of the lifting mechanism, half way between the pivot point and the blade on the bulldozer frame, throws all the weight to the front and holds the tractor and the bulldozer blade into the ground to do the work.

—♦—

New Hydraulic Bottom-Dump Wagon

A new hydraulic bottom-dump wagon on which the tractor driver has complete control of the dumping and door-closing operations from his driving positions has been brought out by the road machinery division of the Euclid Crane & Hoist Co., Cleveland, Ohio. No manual effort is required at the dump as all door motions are oper-



Euclid Hydraulic Bottom-Dump Wagon

ated hydraulically by means of a lever conveniently located at the driver's seat.

Hydraulic pressure is supplied by the Euclid simplified hydraulic pump attached to the rear of the tractor. The door-lifting jack is placed inside the tubular section of the wagon drawbar.

These wagons are designed and built to operate either with the hydraulic pump or by hand, the hand winding mechanism being retained on the rear of the wagon. This eliminates any possibility of the wagon being out of commission if the hydraulic-equipped tractor is tied up.

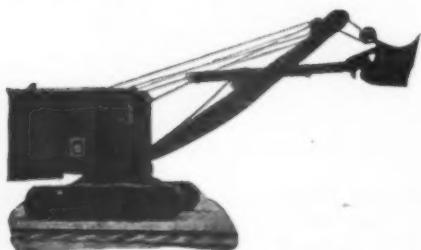
The hoppers are made from extra-heavy steel plate, well braced with steel angles and corner gussets throughout. The doors of extra-heavy medium-carbon steel plate are reinforced with large angle sections. Each door is supported by four heavy steel hinges and designed for maximum road clearance when dumping. The body is balanced on a pair of Euclid heavy-duty ball-bearing track wheels by means of a 4-in.-diameter heat-treated alloy-steel main axle and two 3½-in. diameter stub axles of the same material. A single pair of doors swing under the through axle, allowing the material to be discharged quickly and evenly in uniform windrows, while round corners and properly sloped sides shed the dirt freely at the dump.

The wagons are built in 5½, 6, 7 and 8-yard capacities. The 5½ and 7-yd. wagons are built with a low side for elevating-grader use but can be converted into 6 and 8-yd. capacities by merely adding top extensions to the low side and ends.

New Model Bay City Shovel

An addition to its line of convertible power shovels and cranes has been announced by Bay City Shovels, Inc., Bay City, Mich. The new Model S, Bay City, is a full-revolving convertible power shovel with full-crawler mounting and enclosed steel cab, with gasoline, oil engine or electric power. It weighs 63,000 lb., equipped as a shovel. Capacity is rated as a full 1-yd. shovel or excavator or a 17-ton crane (at 12 ft. radius). Model S is furnished with shovel, dragline, trench hoe, clamshell or crane boom attachments, all of which are convertible.

Model S closely follows the proven design of the Bay City Model R ¾-yd. ma-



The New Model S, Bay City

chine, with exceptionally large diameter center pin and swing circle, cast car body and machinery table, frictionless ball or roller bearings, for all machinery shafting, special analysis steel shafting high pressure lubrication for all parts, machine cut or forged and hardened steel gears, "E-Z" lever control, fast operating speeds and wide clutch surfaces.

The 1-yd. model is powered by Climax "Blue-Streak" 6-in. bore, 7-in. stroke gasoline engine; shovel boom is 21 ft. long with chain crowd and cast manganese dipper; crane booms 35 to 60 ft. in length; crawler tread width 22 in.; ships without dismantling.



An Aggregate Auto Gage

An aggregate auto gage has recently been announced by Toledo Precision Devices, Inc., a subsidiary of the Toledo Scale Co., Toledo, O. It is claimed the device will: Determine the specific gravity of concrete aggregates; determine the per cent of moisture of concrete aggregates; compen-



Toledo Aggregate Gage

sate for surface moisture of concrete aggregates; show exact weight of dry aggregates; indicate the weight of regular run aggregates; show actual weight of surface moisture; make sieve analysis; show moisture within the aggregates themselves; do regular weighing.

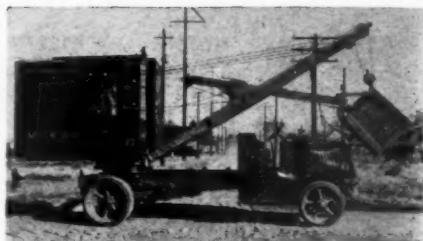
The device is designed primarily for production, laboratory and inspection work. It is claimed to insure correct water-cement ratio, correct proportion of cement to volume of concrete, uniformity of product, strength and durability.



New Truck Shovel

A new truck shovel has been placed on the market by the Quick-Way Shovel Co., Denver, Colo. The new machine is fully convertible for crane, dragline and all other requisites of machinery of this type.

The equipment can be mounted on a 3½-ton truck, or larger, and will allow road travel at truck speed, making it all the more practical for the smaller jobs. The equipment weighs 11,000 lb., complete, and has a 4/10-yd. struck measure bucket.



Quick-Way Truck Shovel Ready for Road Travel

The Quick-Way Shovel Co. has been formed at Denver for the production of this new machine, with John H. Jay as manager. Mr. Jay was formerly with the Iowa Manufacturing Co. of Cedar Rapids, Ia.



New Type Drawing Board Top Eliminates Inking

A new type of drawing board top that is claimed to eliminate the inking of drawings has been placed on the market by W. H. Long Co., 420 North Clark St., Chicago, Ill. The top is an especially fine, white composition which gives a permanent white, smooth, perfect drawing surface, tough, resilient, stain-proof, scratch-proof, mar-proof and washable with soap and water. It comes in any size sheets and is ½ in. thick, and the top edges are slightly rounded. It can be glued or fastened to old boards.

Its use is simple. No manila paper is used. The regular drawing paper is attached directly to this surface, and a 3-H or harder pencil is used. All lines are drawn with a double stroke and with a slight pressure on the pencil. The pressure of the first stroke ridges the paper, and the back stroke fills that valley evenly with lead. The result is a solid, opaque, even edged line, reproductions of which (blue-prints, van dykes, etc.) are stated to be as clear cut and readable as an inked line. Changes can be made in any line by the usual rubbing out process, and the ridges or valleys will not show on reproductions. Because of the resiliency of the board, the indentations in the surface made by the pressure of drawing tools disappear immediately. Due to the use of hard lead which lies in a valley, the lines do not smudge when worked over for any length of time.



A New Portable Pulverizer

Day Pulverizer Co., Knoxville, Tenn., is now manufacturing a new model portable



New Day Portable Crusher

crusher for "Caterpillar" Twenty. These crushers are for use with "Caterpillar" tractors exclusively.

"I still don't know why we didn't hit him"



The narrow escape and the narrow road are close cousins. Once a community makes up its mind to act, it takes only a short time and a comparatively slight outlay to widen a road sufficiently to eliminate most of the accident hazard.

NINETY-horse-power cars—passing and repassing like gusts of wind—on narrow, old roads designed to accommodate the one-horse-power buggy. The wonder is that narrow escapes still are more common than smash-ups

Tarvia is helping highway engineers to give their communities safer, broader roads. For Tarvia construction permits maximum width at minimum cost. A four-traffic-lane Tarvia highway often costs less than a two-lane pavement of the more expensive types of construction.

Yet the low-cost Tarvia road is a safe, smooth, non-skid highway. It is easy to maintain, and with moderate maintenance, will last indefinitely. Tarvia can be utilized with local materials to effect economies that bring traffic-safe roads within the reach of any community.

The *Barrett* Company

New York	Chicago	Philadelphia
St. Louis	Minneapolis	Boston
Detroit	Cleveland	Birmingham
Buffalo	Columbus	Milwaukee
Providence	Syracuse	Cincinnati
Baltimore	Toledo	Rochester
Lebanon	Youngstown	Bethlehem
	Harford	

In Canada:
THE BARRETT COMPANY, Ltd.
Montreal, Toronto, Winnipeg, Vancouver

Tarvia
GOOD ROADS
at LOW COST

Do you mention ROADS AND STREETS when writing? Please do.

Distributor News

A Speechless Convention

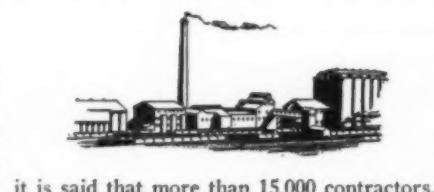
"It was a speechless convention." That's the way the Caterpillar dealer convention recently held in Peoria, was described. Instead of the dealers being lectured, they were given a chance to stroll around, talk their problems over with officials, see the exhibits of the various departments and get acquainted with each other and the new Caterpillar factory which greeted them where two years before they had seen only the mud flats of the Illinois River.

Walter H. Gardner, advertising manager of the Caterpillar Tractor Company located at Peoria, Illinois, was given the credit for what to quote the dealers, was "The best convention I ever saw." Back of Mr. Gardner's years of advertising experience which is said to have put Caterpillar in the class of the 50 leaders in direct mail, are years of sales experience with track-type tractors.

Fifty-three manufacturers who are making equipment to be powered by Caterpillars had 150 new models to display. Practically all of these manufacturers furnished men and literature, and the possibilities for new fields for this equipment as shown by this exhibit were said to be "an eye-opener."

Over 200 dealers from all parts of the country came, saw and approved and according to report enthusiasm was voiced by such hard-boiled dealers as, Willard Shepard of Los Angeles, Frank Halloran of Memphis, Harry Ferris of Spokane, Yancey Bros. of Georgia and Albert Olson of Regina, Sask.

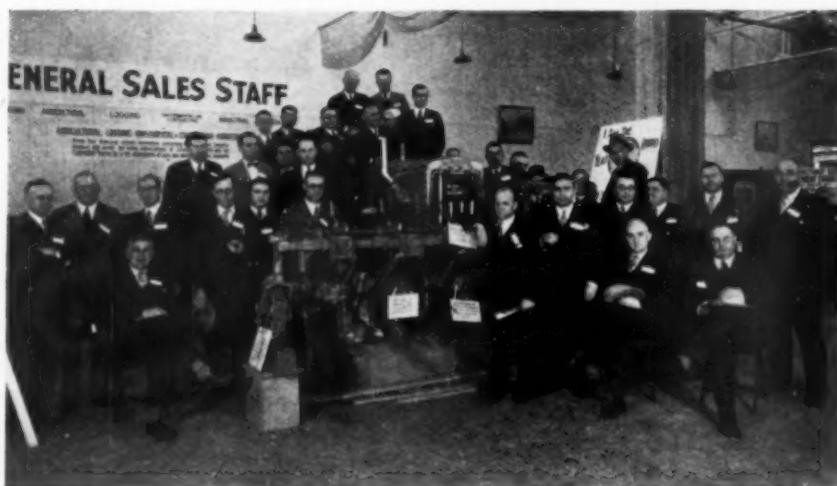
The show remained open to the public for two weeks after the dealers left, and



it is said that more than 15,000 contractors, engineers, city, county, state and governmental officials came by auto and train to see it.

lar line of stone and gravel crushers. All equipment sales will now be handled direct with user or through local jobber.

It is stated that satisfactory dealer connections which have been established for many years will be retained and new connections made in other sections of the country. Stocks that have heretofore been carried at strategic points will be transferred to the company's own agents. These stocks will be kept complete and up-to-



One Group of Interested Dealers From the East at Caterpillar Show

Universal Crusher Increases Distribution Facilities

A change in distribution policy has been announced by the Universal Crusher Company of Cedar Rapids, Iowa, well known manufacturers of a widely used and popu-

date so that Universal crusher owners and prospective users are assured of prompt and efficient service.

The Universal lines have been on the market for over a quarter of a century, and under the new plan many additions and a diversified line of crushing, conveying, screening, washing and loading equipment will be made immediately available to the trade.

Buildings are said to be under construction to take care of the increased need for engineering and shop facilities.



Annual Meeting Worthington Sales Executives

A meeting of the sales executives of the Worthington Pump and Machinery Corporation from all over the United States was held the early part of February for a period of three days.

H. C. Beaver, formerly vice-president of Rolls-Royce of America, was introduced at this meeting as a new vice-president of the Worthington organization. It is stated that Mr. Beaver will devote his efforts principally to the administration of the sales department.

Announcement was made at this time of the advancement of E. E. Yake to the office of vice-president to direct manufacturing and engineering.

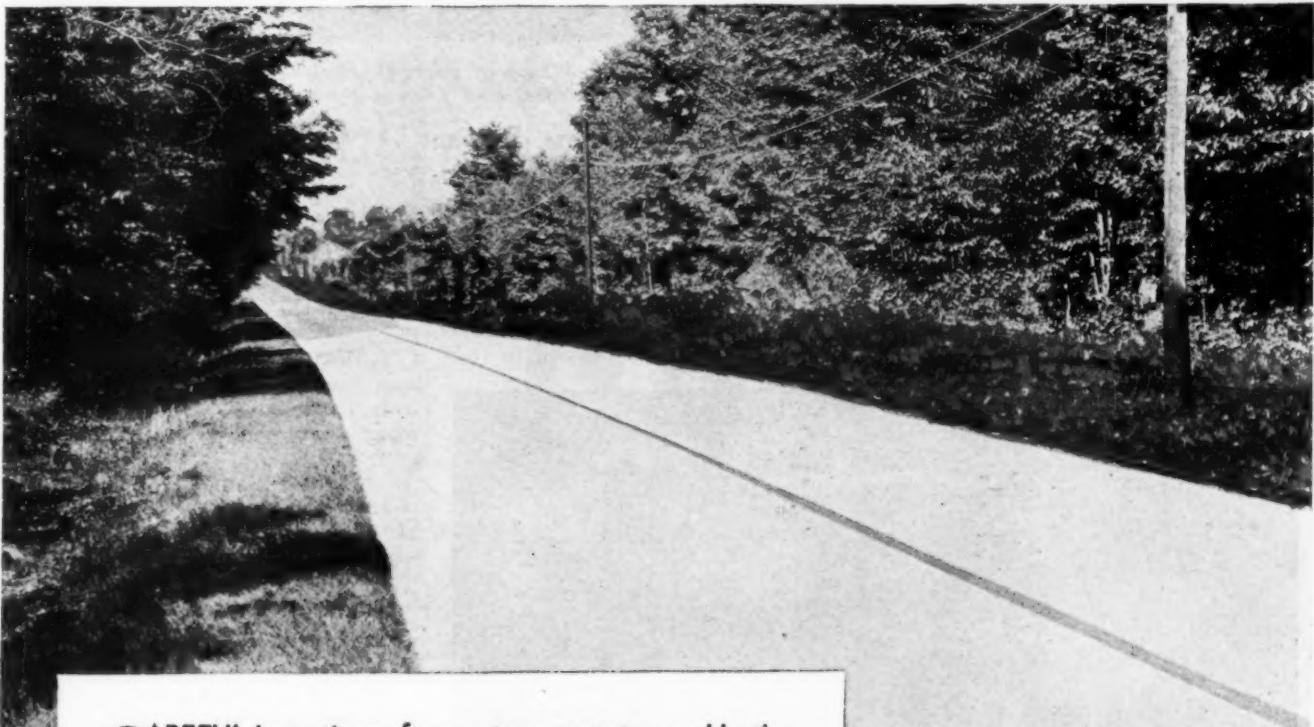
In spite of economic conditions, the statement was made that the company had had a most successful year, having set the same sales quota for 1930 as for 1929 and that 97 per cent of this quota was attained.



Space in New Harvester Building Where in Room 108 x 400 ft. Equipment Was Displayed at the Caterpillar Dealer Convention



AUTHORITY SPEAKS!



CAREFUL inspections of concrete pavements cured by the Calcium Chloride surface method were made by a special committee of the Highway Research Board. Extensive mileage cured under various conditions in many states gave opportunity for comprehensive research and appraisal. No meager, inconclusive observations of just a few pavements.

After exhaustive tests the committee reported that Calcium Chloride surface curing (1) does not create volume changes that cause cracking, (2) does not cause scaling, and (3) attains strengths equivalent to the wetted earth method.

Calcium Chloride surface treatment is the only method other than wetted earth which has passed all conditions set forth by the Highway Research Board as necessary for the proper curing of concrete. Send the coupon for complete information.

Calcium Chloride Publicity Committee

F L A K E
**CALCIUM
CHLORIDE**

"develops full strength concrete"



Send the coupon to any one of these companies:

The Columbia Products Company, Barberton, Ohio
The Dow Chemical Company, Midland, Michigan
Solvay Sales Corporation, 61 Broadway, N. Y. City

Please send complete data on Calcium Chloride concrete curing practice.

Name _____

Position _____

Address _____

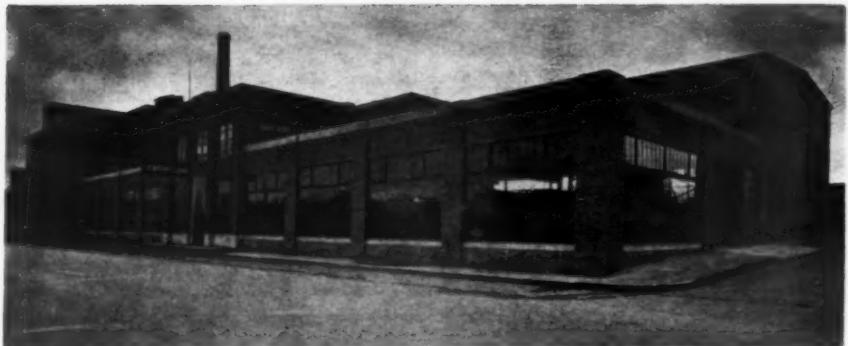
R&S 3-31

Beckwith Machinery Co. Occupies New Plant

There is no mistaking the lines of machinery handled by the Beckwith Machinery Company of Pittsburgh, for in their new and handsome structure at 6550 Hamilton Avenue, East Liberty, a 204-ft. plate-glass front allows the approaching visitor a full view of tractors and tractor equipment to meet every need.

The display room occupies the entire first floor front, with executive offices above. The rear section of the building is one gigantic room, 204 ft. in length by 60 ft. wide, with storage space, equipment and repair shop all served by a 55-ft.-span, 5-ton electric crane. The siding is located directly on the main line of the Pennsylvania R. R.

The continuous wall of windows gives maximum amount of light as long as daylight lasts, and a scientific lighting system takes over the work of the sun when night comes on. Every new and scientific means has been adopted to increase speed in the handling of both incoming and outgoing railroad shipments.



Show Room, Warehouse and Shop of Beckwith Machinery Company, 6550 Hamilton Avenue, East Liberty, Pittsburgh

Allis-Chalmers Opens Sioux Falls Branch

Announcement has been made of the opening of a new branch office at Sioux Falls, South Dakota, to serve state and county highway department and contractors with track type and industrial wheel tractors put out by the Allis-Chalmers Manufacturing Company. In addition to trac-

of Oregon. Mr. Jolley was formerly connected with the Firestone Tire Company.

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John C. Louis Co., Inc., Take Larger Quarters

A modern one-story daylight building, 72 x 158 ft., at 511 West Pratt Street, Baltimore, has been taken over by the John C. Louis Company, Inc., construction equipment distributors, according to a news note from Good Roads Machinery Company, whose agents they are in Baltimore territory.

For almost thirty years this organization has been situated at 221 South Eutaw Street, where John C. Louis first established and developed a successful business. In 1927 the John C. Louis Company was launched, because of Mr. Louis' desire to allow his loyal co-workers to share in the business which they had helped to develop. Need for larger quarters speaks for the continued growth of the company. George C. Schmidt is secretary of the company.



Looking Through the Plate-Glass Front of the Beckwith Display Room

It is said that the parts room is stocked with about \$40,000 worth of tractor and equipment parts so that immediate replacement service is assured. In the display room may be seen every size of Caterpillar road grader and motor patrol, bulldozers, crawler-type wagons, scarifiers, revolving scrapers, wheeled scrapers, ditching machines, etc., it being the boast of the company that "if it is to be had in tractor equipment Beckwith has it."

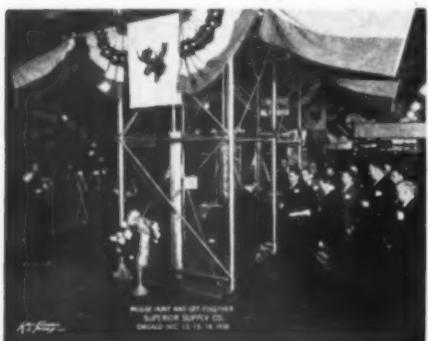
—♦—

tors, it is stated that the branch will also stock a full line of road building and construction equipment.

Karl H. Schweider, who pioneered the Allis-Chalmers agricultural branch in Sioux Falls three years ago, has been made manager of the new branch. Mr. Schweider is familiar with South Dakota territory, and for the past six months has served as assistant sales manager at Milwaukee, supervising the agricultural sales in the northwest.

Headquarters at Sioux Falls will be located at 202 N. Main Street, a new building, where they will occupy 11,000 feet of floor space. Various models of tractors and allied equipment will be displayed in a spacious show room. Competent factory mechanics will be in charge of the service department and a complete stock of parts will be on hand for the entire line of equipment.

—♦—



Seen at Superior Supply Co. Party



Union Steel Co. Shows New Accessories at Road Show

A whole crop of improved supports, spacers, chairs, etc., for fabricating steel work in road building was introduced at the Road Show in St. Louis recently by the Union Steel Products Company of Albion, Michigan. A color scheme of orange and black with neatly arranged panel boards heightened the effect of this aggregation of weird forms and shapes.

—♦—

Manufacturer of nationally advertised construction equipment offers an excellent opportunity to experienced equipment salesmen to start in their own business. Very little capital required. Several important cities now open for immediate action. Full particulars. Address Box 1637, c/o Roads and Streets, 420 Lexington Avenue, New York City.



Florida



Indiana



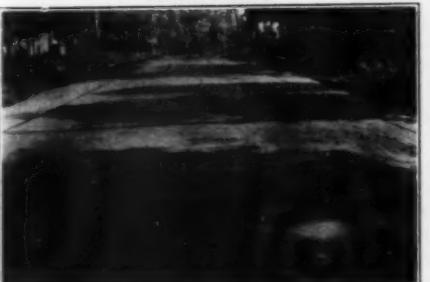
Kentucky



Maryland



North Carolina



Virginia

SAVE THE OLD ROAD
AND
THE TAXPAYER'S MONEY
REDUCE TRAFFIC IMPACT
AND
THE MAINTENANCE COST
BY
RESURFACING WITH

Westphalt
TRADE MARK

THE IMPROVED ASPHALT PAVEMENT

West Process Pavement Co., Inc.
LOUISVILLE, KY.

LICENSEES

Bituminous Sales Co.
Harrisburg, Pa.

R. G. Lassiter Co.
Raleigh, N. C.

West Process Pavement Co. of Va.
Richmond, Va.

Central Westphalt Pavement Co.
St. Louis, Mo.



Georgia

Service Exchange

For Manufacturers or Distributors

Editor's Note.—From time to time we receive letters from distributors wishing to be put in touch with manufacturers of certain lines of equipment, or from manufacturers seeking representatives of their products. Items of this kind will be published and names and addresses furnished interested persons upon request.

New Lines Wanted

Distributor located in Virginia wishes to make connection to represent manufacturer of manganese crushing plates and jaw rock crushers.

Export manager for American manufacturer of road graders is in a position to handle an additional line of non-competing construction machinery, for manufacturer seeking foreign representation.

Manufacturer's representative located in New York City, now handling pumping machinery, would like to take on two or three additional lines serving the same field as his present account.

Manufacturer's representative with 25 years' sales experience, conversant with all types of pumps and their field, desires agency for either New York or export territory, or both.

Wanted line of picks, sledges and crow bars, spades, shovels and similar implements by New Jersey broker, with warehouse facilities, contacting New York and New Jersey jobbers.

Sales engineer, experienced in earth-moving machinery, desires connection on salary or salary and commission basis. Wide acquaintance with machinery dealers, oil and gas industry, pipe line contractors and material men. References.

Warehouse facilities for serving Pittsburgh territory. Would like to secure line of portable and stationary conveyors.

Wanted agency for any type of building specialties or contractors' machinery except mixers. Twenty years experience. Familiar with all types of contractors' machinery. Could act as sales manager for Atlantic coast line with dealers.

Distributor covering Wisconsin and Illinois territory wishes to add to present lines. Thoroughly familiar with bituminous materials and equipment for handling.

Distributor located in Portland, Oregon, desires line of stationary diesel engines, from 75 to 150 hp. to serve western trade for driving rock crushers and industrial plants.

Wanted line of street markers or other traffic equipment on exclusive basis by distributor covering New Jersey and New York territory.

Manufacturer's representative, covering Massachusetts, Rhode Island and southern New Hampshire, would like to secure line of speed reducers and gears.

Representative in northwest desires to handle, on commission basis, line of road building and maintenance machinery, revolving scrapers, tractors, rotary snow plows and V-type push plows.

Wanted exclusive sales rights for state of Mississippi for line of automatic or self-loading wheeled scraper.

Equipment distributor in Pacific northwest desires line of road-building equipment, structural building equipment, dump bodies and truck hoists.

Wanted for Buffalo, Niagara frontier and western New York territory a good power and heating boiler account.

Distributor of building specialties covering a territory of 100-mile radius from Chicago is equipped to represent additional lines.

Representatives Wanted

Attractive territory open in states south and west of Chicago by manufacturer of cut-to-length, easily-erected standardized steel highway bridges, for spans up to and including 40 ft. Product sells to highway commissioners and superintendents.

Manufacturer of patented reflecting signs and devices desires representative for New York City, Long Island, Westchester County and adjacent territory. Some one selling other products to municipalities preferred.

Manufacturer of special corrosion-preventing lubricant for road machinery and construction equipment wishes to establish distributing points throughout the country.

Open territory in New York and New England states for aggressive distributor wishing to take on line of hoisting machinery and air compressors.

Manufacturer of air compressors and contractors' tools has number of desirable territories open. Full cooperation will be extended to distributors.

Southwest and middle-west distributors wanted by manufacturer of metal lath, corner beads, channels and reinforcing mesh.

Long established and well-known manufacturer of industrial locomotives wishes to make contacts with qualified distributors. Locomotive line includes steam, gasoline, gas-electric and oil-electric. Supported by national trade journal advertising.

Manufacturer of complete line street repair equipment, tar kettles, heaters, patching plants, torches, etc., has open territory in southeastern states and desires active distribution. Territory largely open from Virginia to gulf states, inclusive, also state of Oklahoma.

Eastern manufacturer of grade-rippers, scrapers and road hoes has desirable territory open for distributors.

Manufacturer of asphalt ingredient, adaptable for use in the road or industrial field, is seeking representatives for desirable territory in various parts of the country.

California territory available for distributor wishing paving expansion joint account.

Good, unassigned territory available for distributors and manufacturer's representatives to handle paving expansion joint line.

Manufacturer of transverse testing machines desires to build up distribution organization in this country and abroad.

Several desirable states open. Wanted distributing organizations covering entire states by manufacturer of mechanical spreader.

Territory open in several states for representatives to handle grade-rippers, mechanical plows.

Manufacturer of metal tie and spacer wishes to establish distributing points throughout the country.

Manufacturer of contractors and builders levels and transits is seeking district sales manager. Exclusive contract given. Excellent territory still available. Backed by national advertising.

Well established manufacturers' representatives wanted to handle sand and gravel pumps and equipment, in key cities, by successful manufacturer of high grade dredging pumps and hydraulic dredging equipment. Give character of equipment now being handled and territory covered.

Manufacturer of complete line of construction equipment, mixers, saw rigs, plaster and mortar mixers and pumps, has an open territory in the state of Maine and is looking for an aggressive distributor to represent him there.

Manufacturer of patented luminous highway danger signs and signals is interested in securing aggressive representation in various parts of this country and Canada.

One of the leading manufacturers of surveying instruments in the United States is seeking responsible agents in all sections of the country. Instruments are nationally advertised in all leading engineering journals.

Maintenance Costs on Buffalo, N.Y., Brick Streets

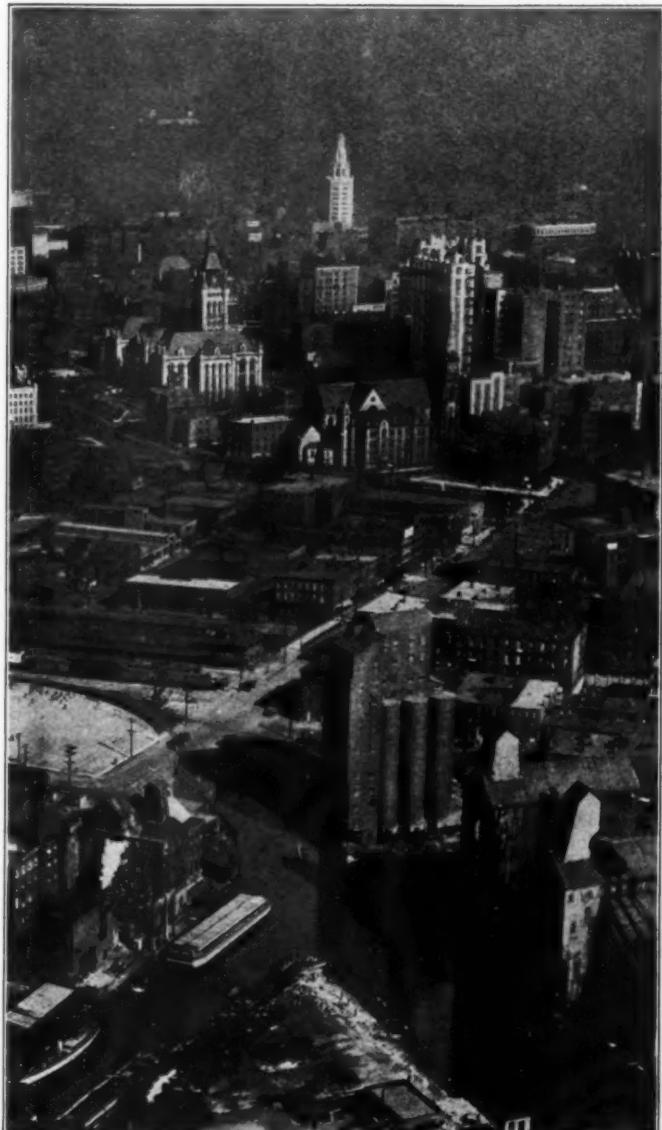


Photo by Underwood & Underwood

Yes—we would like you to mention ROADS AND STREETS

**COST PER SQUARE
YARD ON STREETS
MAINTAINED**

Year	Upkeep
'19 - '20	\$0.0249
'20 - '21	0.0171
'21 - '22	0.0204
'22 - '23	0.0158
'23 - '24	0.0133
'24 - '25	0.0229
'25 - '26	0.0397
1927	0.0024
1928	0.0099
Yearly Av.	0.0185

FOR the past 40 years, Buffalo, N.Y. has, through its Department of Public Works, Department of Engineering, kept accurate records on its pavement maintenance.

The above table compiled from the Department's Annual Reports shows the true cost of brick pavement on which the "10 year guarantee" has expired.

Note the low cost of brick upkeep!

It is from 4 to 6 times less than the maintenance on two other pavement types receiving comparable traffic.

Now for one specific—but not unusual—example. Franklin Street. It has carried Buffalo's heavy traffic for 37 years with an annual maintenance cost of only 1 cent per square yard.

Each passing year gives further evidence of the economy of brick. It lasts so long and costs so little because it withstands weather as well as traffic damage.

*For additional information, address National
Paving Brick Manufacturers Association, 1245
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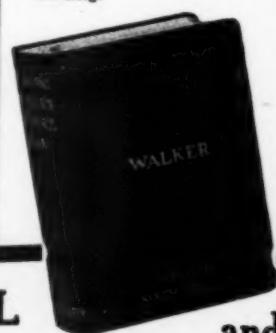
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